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OFFICE OF WATER RESEARCH AND TECHNOLOGY

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 13, NUMBER 19
OCTOBER 1, 1980

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Office of Water Research and Technology
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The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most our our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus.** Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

CHEMISTRY OF THE SPRING WATERS OF THE OUACHITA MOUNTAINS EXCLUDING HOT SPRINGS, ARKANSAS,
Arkansas Water Resources Research Center, Fayetteville.
G. H. Wagner, and K. F. Steele.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203466, Price codes: A09 in paper copy, A01 in microfiche. Publication No 69, March 1980. 180 p, 41 Fig, 14 Tab, 39 Ref. OWRT B-055-ARK(1). 14-34-0001-8061.

Descriptors: *Springs, *Wells, *Chemical analysis, *Mineralogy, Ions, Cations, Salts, Chemical precipitation, Metals, Silicates, Temperature, Groundwater, Hot springs, Arkansas, Photometry, Flame photometry, Water analysis, Water quality, Atomic absorption.

Chemical analysis of the waters from 93 springs and 9 wells in the Ouachita Mountains (excluding Hot Springs), Arkansas, are reported. The study was carried out to investigate groundwater quality, its subsurface temperature, and its potential as a mineral pathfinder. The samples were collected and stored in clean polyethylene containers for SiO2, SO4, Cl, PO4, and NH3 analyses. Alkalinity, pH, temperature, and conductivity were measured at the site and raw water was filtered to remove any solid contaminants. Atomic absorption (AA), spectrophotometry, or flame emission were employed in the analyses of all cations in the acidified raw water. Springs with anomalously high temperatures, metal content, and high silica content are likely to indicate known, local mineralization. Threshold and anomalous concentrations of metals had to be determined for a specific area. Anomalous concentrations of a base metal in an individual spring indicates a mineral deposit within one mile in 41% of the cases. Barite mineralization was indicated by a high Ba concentration. High strontium concentrations were not found in springs near known Sr mineralizations and concentrations of Li and K gave no indication of nearby lithiophorite and cryptomelane. All tables and figures are given at the end of the report. (Sidney-IPA)
W80-06010

WATER QUALITY OF FLORIDA SPRINGS,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. J. Slack, and J. C. Rosenau.
Florida Bureau of Geology Map Series 96, 1979. 1 Sheet, 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Water quality, *Florida, *Maps, *Springs, *Groundwater, Discharge(Water), Water chemistry, *Floridan aquifer.

A major part of Florida's ground-water discharge is from about 300 springs. Estimated discharge is 8 billion gallons per day, or more than twice the quantity of water pumped for all uses in the State. The prevalent chemical types of water discharging from the major springs of Florida, in their order of importance are: calcium-magnesium bicarbonate, sodium chloride, a blend of two or more chemical types, and calcium sulfate. Based on available data, the chemical quality of the water is generally excellent and relatively constant with time although some springs may occasionally discharge organic brown water. (Kosco-USGS)
W80-06058

2. WATER CYCLE

2A. General

CALIBRATION OF A DISTRIBUTED ROUTING RAINFALL-RUNOFF MODEL AT FOUR RUBAN SITES NEAR MIAMI, FLORIDA,
Geological Survey, Bay St. Louis, MS. Water Resources Div.
W. H. Doyle, and J. E. Miller.
Geological Survey Water Resources Investigations 80-1, February 1980. 87 p, 29 Fig, 25 Tab, 18 Ref.

Descriptors: *Rainfall-runoff relationships, *Computer models, *Model studies, *Urban runoff, *Florida, Storm water, Urban hydrology, Flow characteristics, Soil moisture, Analytical techniques, Mathmatical models, *Miami(FL).

Urban stormwater data from four Miami, Fla. catchments were collected and compiled by the U.S. Geological Survey and were used for testing the applicability of deterministic modeling for characterizing stormwater flows from small land-use areas. A description of model calibration and verification is presented for: (1) A 40.8 acre single-family residential area, (2) a 58.3-acre highway area, (3) a 20.4-acre commercial area, and (4) a 14.7-acre multifamily residential area. Rainfall-runoff data for 80, 108, 114, and 52 storms at sites, 1, 2, 3, and 4, respectively, were collected, analyzed, and stored on direct-access files. Rainfall and runoff data for these storms (at 1-minute time intervals) were used in flow-modeling simulation analyses. A distributed routing Geological Survey rainfall-runoff model was used to determine rainfall excess and route overland and channel flows at each site. Optimization of soil-moisture- accounting and infiltration parameters was performed during the calibration phases. The results of this study showed that, with qualifications, an acceptable verification of the Geological Survey model can be achieved. (Kosco-USGS)
W80-06060

HYDROLOGY OF JUMPER CREEK CANAL BASIN, SUMPTER COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W80-06063

OXIDATIVE POLYMERIZATION OF DISSOLVED PHENOLS BY SOLUBLE AND INSOLUBLE INORGANIC SPECIES,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 5A.
W80-06113

STOCHASTIC PARAMETER ESTIMATION PROCEDURES FOR HYDROLOGIC RAINFALL-RUNOFF MODELS: CORROLATED AND HETEROSCEDASTIC ERROR CASES,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
S. Sorooshian, and J. A. Dracup.
Water Resources Research, Vol 16, No 2, p 430-442, April 1980. 6 Fig, 6 Tab, 32 Ref. NSF ENG-77-11137.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, Stochastic processes, Runoff, Rainfall, Precipitation(Atmospheric), Discharge(Water), Water levels, Stage-discharge relations, Flow, Streamflow, Hydrology, Errors, Rainfall-runoff models.

A maximum likelihood estimation procedure was presented through which two aspects of the streamflow measurement errors of the calibration phase were accounted for. First, the correlated error case was considered where a first-order autoregressive scheme was presupposed for the additive errors. This proposed procedure first determined the anticipated correlation coefficient of the errors and then used it in the objective function to estimate the best values of the model parameters. Second, the heteroscedastic error case (changing variance) was considered for which a weighting approach, using the concept of power transformation, was developed. The performances of the new procedures were tested with synthetic data for various error conditions on a two-parameter model. In comparison with the simple least squares criterion and the weighted least squares scheme of the HEC-1 of the U.S. Army Corps of Engineers for the heteroscedastic case, the new procedures constantly produced better estimates. The procedures were found to be easy to implement with no convergence problem. In the absence of correlated errors, as theoretically expected, the correlated error procedure produces the exact same estimates as the simple least squares criterion. Likewise, the self-correcting ability of the heteroscedastic error procedure was effective in reducing the objective function to that of the simple least squares as data gradually became homoscedastic. Finally, the effective residual tests for detection of the above-mentioned error situations were discussed. (Sims-ISWS)
W80-06138

A STOCHASTIC-CONCEPTUAL ANALYSIS OF RAINFALL-RUNOFF PROCESSES ON A HILLSLOPE,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2E.
W80-06140

A FREQUENCY DISTRIBUTION FOR ANNUAL FLOODS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2E.
W80-06152

SOME PARADOXES IN THE HISTORY OF HYDRAULICS,
Iowa Univ., Iowa City.
H. Rouse.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15475, p 1077-1084, June 1980.

Descriptors: *Flow resistance, *Flow system, *Flow, History, Hydraulics, Roughness(Hydraulic), Resistance, Roughness coefficient, Hydrodynamics, Cavitation, *Resistance coefficients, Hydraulics history, Roughness, Paradoxes, Archimedes, Aristotle.

Successive instances in the development of hydraulics were cited in which conditions were not as they were generally assumed to have been. Emphasis was laid upon problems of fluid resistance, beginning with Nature's 'abhorrence of a vacuum' at the time of Aristotle and extending to the relative-roughness diagrams of the very recent past. Much of the material was published first in 1957, in 'History of Hydraulics', and later in 1976, in 'Hydraulics in the United States'. (Roberts-ISWS)
W80-06192

2B. Precipitation

ON SOME ASPECTS OF CLIMATOLOGY ASSOCIATED WITH A DAM,
Witwatersrand Univ., Johannesburg (South Africa).
T. G. J. Dyer.
Water SA, Pretoria Vol 4 No 3, p 113-118, 1978. 7 fig, 11 ref.

Descriptors: *Climatology, *Rainfall, *Inflow, *Mathematical stuies, *Fluctuations, *Dam construction, Evaporation, Transpiration, Evapotranspiration, Wavelenghts, Forecasting, Economic prediction, Future planning(Projected), Regression analysis, Time series analysis, Frequency analysis, Hydrology, South Africa.

The behavior of spatial mean rainfall series in Gaborone, South Africa, was investigated in order to perdict the best year in which to build a new dam. Suitable mathematical analysis of rainfall data would give estimates for rainfall and dam inflow for the future including the patterns of negative and positive anomalies. A new approach, the time series analysis, was employed using harmonic analysis containing adjustments for pseudo-peridodic oscillations. The width of the wave band can be tested for significance and the preciseness of a wave length can also be found. The rainfall in the local dam area was analyzed for the period 1909/

10 to 1975/6. Oscillations with long wave lengths were absent and there was a strong ten year wave for the series of annual inflow totals. Variances in the fit of the data to a trigonometric regression expression were accounted for by extreme vales in the data. The estimated series for inflow and rainfall were smoothed using a five term binomial filter. It was suggested from the data that the dam should be built during the period of positive rainfall anomalies over the interval 1980/90. (Sidney-IPA)
W80-06071

PRELIMINARY CLOUD MICROPHYSICS STUDIES FOR TEXAS HIPLEX 1979,
Texas A and M Univ., College Station. Dept. of Meteorology.
A. B. Long.
Report No LP-124 prepared for Texas Department of Water Resources, Austin, TX March 1980. 82 p, 15 Fig, 10 Tab, 2 Ref, 1 Append. 14-06-D-7587.

Descriptors: *Cloud physics, *Chemistry of precipitation, *Precipitation(Atmospheric), *Clouds, *Storm structure, Climatology, Meteorology, Atmospheric physics, Weather data, Texas, On-site data collection, Aircraft, Instrumentation, Data processing, Dew point, Air temperature.

Initial cloud microphysis studies by Texas A and M University of the important precipitation mechanisms is convective clouds in the Texas HIPLEX region are reported. The data collected will be used to test rain enhancement techniques for this specific type of cloud. A fully instrumented aircraft collected the data in the field during the period, May 21 to July 20, 1979. The thermodynamic, kinematic, and micro-phyical properties were evaluated and the data were recorded on magnetic tape for further evaluation. Clouds suitable for microphysical studies were selected by a specific set of rules. Certain microphysical parameters must be met for a cloud to be selected when the aircraft makes an initial pass through the cloud. About half of the clouds met the selection rules and those which did not, had tops which were too cold, initial ice particle concentration was too high, or precipitation had already begun. Analysis of the data showed that as precipitation falls through subcloud air its temperature is decreased and dew point increased. This may be an example o the wet-bulb process operating within subcloud air or it may indicate penetration of potentially downdraft air into the subcloud region. Of the clouds studied, it was concluded that the ice process was necessary for significant precipitation to occur. (Sidney-IPA)
W80-06072

DRAFT, CONSTRUCTION AND OPERATION OF A SEQUENTIAL RAIN SAMPLER,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
For primary bibliographic entry see Field 7B.
W80-06084

RAIN DROP SIZES AND RAINFALL RATE MEASURED BY DUAL-POLARIZATION RADAR,
Ruthrford and Appleton Lab., Slough (England).
For primary bibliographic entry see Field 7B.
W80-06087

DIURNAL RAINFALL VARIATION IN NORTHEAST BRAZIL,
Conselho Nacional de Desenvolvinento Cientifico e Technologico, Rio de Janeiro (Brazil); and Instituto de Pesquisas Espaciais, Sao Jose dos Campso (Brazil).
V. E. Kousky.
Monthly Weather Review, Vol 108, No 4, p 488-498, April 1980. 10 Fig, 1 Tab, 12 Ref.

Descriptors: *Rainfall, *Diurnal, *Coasts, Coastal plains, Diurnal distribution, Nocturnal, Winds, Sea breezes, Temperature, Precipitation, Areal, *Brazil, *Diurnal rainfall, *Northeast Brazil, *Amazon River, Rainfall variation, Convergence, Onshore flow, Offshore land breeze.

The diurnal rainfall variation in northeast Brazil was investigated for the period 1961-1970. Most coastal areas were found to experience a nocturnal maximum in rainfall activity, probably due to convergence between the mean onshore flow and the offshore land breeze. Areas 100-300 km inland experience a daytime maximum, associated with the development and inland advance of the sea breeze. The diurnal rainfall variability, at most interior locations, seems to be due to mountain-valley breezes. Seasonal variations are noted for areas of the north coast of Brazil. Source, Located near the moth of the Amazon river, experiences a nocturnal maximum between january and May, and an afternoon maximum between June and September. Evidence was presented that shows that this seasonal variation is linked to the seasonal variation in the low-level mean flow. Seasonal variations in the mean monthly rainfall for coastal areas was shown to correlate well with the intensity of the land breeze, which was represented by the difference between the mean sea surface temperature and the mean air temperature over land. (Roberts-ISWS)
W80-06094

THE NATURE OF RAINFALL FLUCTUATIONS IN SUBTROPICAL WEST AFRICA,
National Center for Atmospheric Research, Boulder, CO.
S. E. Nicholson.
Monthly Weather Review, Vol 108, No 4, p 473-487, April 1980. 11 Fig, 3 Tab, 29 Ref. NSF ATM77-21547, GA-10651.

Descriptors: *Rainfal, *Fluctuations, *Variability, *Africa, Droughts, Arid climates, Semiarid climates, Arid lands, Subtropic, Data processing, Correlation analysis, Precipitation(Atmospheric), Weather, Climatology, Meteorology.

The nature of rainfall fluctuations in the West African subtropics was described on the basis of three analyses of rainfall departures. Areally averaged, normalized rainfall departure seris for the years 1901-75 were derived for four semi-arid sub-Sharan climatic zones: the Sahelo-Saharan, the Sahel, the Soudan, and the Soudano-Guinean. Similar series were derived for four or five regions within each zone, and the regional series were intercorrelated. Finally, correlation between annual rainfall departure maps was used to determine frequently occurring rainfall anomaly types. Several characteristics of West African climate variation emerged from these investigations. A strong coherence of variation occurred throughout the region from approximtely 20 - 10 deg N, a latitude which frequently marks a climatic discontinuity with large departures of opposite sign prevailing to the north and south. this coherence was very pronounced in both the north-south and east-west directions, although certain longitudinal sectors occasionally behave differently from the rest of the zone. Such a case resulted in a mixed configuration of drought, with negative anomalies prevailing only within certain sectors. The determined rainfall anomaly types represented several drought types for the Sahel, characterized by their various relations to conditions elsewhere on the continent. In general, rainfall fluctuations in the West African subtropics were more commonly characterized by a contraction or expansion of the desert belt, rather than by its north-south displacement. (Sims-ISWS)
W80-06095

EFFECTS OF CHEMICAL DEFOLIATION OF AN ABIES GRANDIS HABITAT ON AMOUNTS AND CHEMISTRY OF THROUGHFALL AND STEMFLOW,
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA.
A. R. Tiedemann, J. D. Helvey, and T. D. Anderson.
Journal of Environmental Quality, Vol 9, No 2, p 320-328, April-June 1980. 4 Fig, 5 Tab, 31 Ref.

Descriptors: *Forests, *Chemistry of precipitation, *Nutrients, *Interception, Trees, Fir trees, Grand fir trees, Defoliants, On-site investigations, Throughfall, Stemflow, Water chemistry, Forestry, Water pollution sources, *Defoliation effects.

Amounts and chemistry of gross precipitation, throughfall, and stemflow were measured before and after chemical defoliation of a coniferous forest stand in eastern Washington. Throughfall (T) in the natural stand was related to gross precipitation (P) b the equation $T = 0.842P - 0.182$ with a coefficient of determination (R sq) of 0.972. Throughfall and stemflow increased significantly after defoliation, but the actual amounts were small. Cross precipitation before defoliation contained 0.47 mg/liter total nitrogen (T-N), 0.06 mg/liter total phosphorus (T-P), and0.7 mg/liter total cations (Ca, Mg, Na, and K). Total inputs between 24 August 1975 and 1 June 1976, were 0.84, 0.07, and 0.90 kg/ha for T-N, T-P, and total cations, respectively. Approximately 80% of the total annual precipitation was normally received during the period sampled. Concentrations of chemical constituents were increased up to 15 times in throughfall and up to 48 times in stemflow compared to gross precipitation. Ratios of nutrient delivery (Kg/ha) before defoliation as gross precipitation/throughfall/stemflow were 1.00:1.01:0.02 for T-N, 1.00:3.78:0.15 for T-P, and 1.00:7.57;0.20 for total cations. Defoliation reduced concentration of ammonium-N and increased concentration of T-P in throughfall. Concentrations of other measured constituents were not changed. Delivery of all nutrients to the forest floor, however, was greater after defoliation because of increased amounts of throughfall and stemflow. Comparisons of summer with winter storms and dry fallout with precipitation indicated that: (1) T-P and K are of local origin; (2) N probably originates from passage of air masses over urban and industrial areas, automobile exhaust, and agriculture (fertilization); and (3) Na and Mg are of marine origin. (Sims-ISWS)
W80-06105

STOCHASTIC PARAMETER ESTIMATION PROCEDURES FOR HYDROLOGIC RAINFALL-RUNOFF MODELS: CORROLATED AND HETEROSCEDASTIC ERROR CASES,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W80-06138

ON THE STATISTICAL CHARACTERISTICS OF DROUGHT EVENTS,
California Univ., Los Angeles. School of Engineering and Applied Science.
J. A. Dracup, K. S. Lee, and E. G. Paulson, Jr.
Water Resources Research, Vol 16, No 2, p 289-296, April 1980. 6 Fig, 4 Tab, 9 Ref. NSF ENG77-11137.

Descriptors: *Droughts, *Streamflow, *Precipitation(Atmospheric), *Model studies, Mathematical models, Statistical models, Statistics, Runoff, Rainfall, Rivers, Low flow, Low-flow frequency, Correlation analysis, Hydrologic data, Climatology.

Several statistical tests were performed on streamflow series for purposes of analyzing multiyear drought events. These statistical tests on both high-flow and drought event parameters included: (1) stationarity in terms of their linear trend; (2) randomness in terms of lag-1 serial correlation; (3) correlation and cross correlation between these parameters (duration, magnitude, and severity). The test results and their implications were discussed in relation with the characterization of high-flow and drought event series. Two types of envelopes for drought duration and severity were presented that use Tschebycheff's inequality. These envelopes give an excellent indication of the maximum response of a watershed in terms of drought duration and severity during the period of record. (Sims-ISWS)
W80-06147

ON THE DEFINITION OF DROUGHTS,
California Univ., Los Angeles. School of Engineering and Applied Science.
J. A. Dracup, K. S. Lee, and E. G. Paulson, Jr.
Water Resources Research, Vol 16, No 2, p 297-302, April 1980. 2 Fig, 1 Tab, 18 Ref. NSF

ENG77-11137.

Descriptors: *Droughts, *Streamflow, *Soil moisture, *Precipitation(Atmospheric), Analytical techniques, Data processing, Rainfall, Runoff, Low flow, Low-flow frequency, Time series analysis, Hydrologic data, Climatology, Meteorology, Hydrology, Drought definition.

Several considerations for developing a practical, analytical definition of droughts were discussed. These considerations included: (1) selection of the nature of the water deficit to be studied (hydrological, meteorological, or agricultural); (2) selection of the averaging period used to discretize a continuous time series (months, seasons, or years); (3) selection of the truncation level used to separate droughts from the remainder of the time series (mean or median); and (4) method of regionalization or standardization. These decisions were discussed in terms of their impacts on various approaches to drought frequency analysis. Drought events were considered to be composed of duration, magnitude (average water deficiency), and severity (cumulative water deficiency). An application of the proposed drought definition procedure was presented for the case of a frequency analysis of multiyear hydrologic droughts. (Sims-ISWS)
W80-06148

EROSIVITY VALUES FOR INDIVIDUAL DESIGN STORMS,
Science and Education Administration, Boise, ID.
For primary bibliographic entry see Field 2J.
W80-06195

2C. Snow, Ice, and Frost

PERFORMANE OF V.H.F. AERIALS CLOSE TO A SNOW SURFACE,
British Antarctic Survey, Cambridge (England).
C. S. M. Doake, and M. Gorman.
Journal of Glaciology, Vol 22, No 88, p 551-553, 1979. 1 Fig, 1 Tab, 3 Ref, 1 Append.

Descriptors: *Sounding, *Ice, *Antennas, *Instrumentation, Radar, Surfaces, Snow, Foreign research, Foreign countries, Electrical impedance, Frequency, Masurement, On-site investigations, Standing waves, V.H.F., Voltage standing-wave ratio.

Measurements of aerial admittance as a function of height above a snow surface show that when the surface temperature is below freezing, the aerial performane is insensitie to slight surface irregularities. (Humphreys-ISWS)
W80-06098

A RECOMMENDATION FOR THE APPLICATION OF THE ROCH INDEX FOR SLAB AVALANCHE RELEASE,
Rocky Mountan Forest and Range Experiment Station, Fort Collins, CO.
R. A. Summerfeld, and R. M. King.
Journal of Glaciology, Vol 22, No 88, p 547-549, 1979. 1 Tab, 7 Ref.

Descriptors: *Avalanches, *snow management, *Slope stability, *Forecasting, Movement, On-site investigatins, Snowpacks, Shear, Analysis, On-site data collections, Slabs, Snow.

Detailed measurements on several avalanches verify that a Daniels' type statistical correction to roch's stability index would accurately predict snow-slope instability. It was recommended that one-half the median of at least 50 shear-strength masurements be used as a measure of the strength of a weak layer. (Humphreys-ISWS)
W80-06099

'SAW-TOOTH' MORAINES IN FRONT OF BODALSBREEN, SOUTHERN NORWAY,
University Coll., Cardiff (Wales). Dept. of Geology.
J. A. Matthews, R. Cornish, and R. A. Shakesby.
Journal of Glaciology, Vol 22, No 88, p 535-546, 1979. 6 Fig, 3 Tab, 39 Ref.

Descriptors: *Glaciology, *Glacial drift, *Topography, *Geomorphology, Shape, On-site investigations, Profiles, Surveys, Measurement, Lichens, Analysis, Foreign countries, *Norway, Glacier Bodalsbreen, Saw-tooth profile.

A series of end moraines, with a remarkable saw-tooth pattern, were reported from the glacier foreland of Bodalsbreen, a northern outlet of the ice cap Jostedalsbreen. The three-dimensional morphology of the moraines was described and analyzed. Historical records and lichenometric measurements indicate that they were deposited after the 'Little Ice Age' glacier maximum of the mid-eighteenth century. It was inferred that the local topography of Bodalen was conducive to the formation of a heavily crevassed pecten at the snout of Bodalsbreen, which produced the end moraines by a push mechanism during minor glacier advances. The observations suggest that pushing may be an underestimated mechanism in moraine ridge formation generally. (Humphreys-ISWS)
W80-06100

FORCES ON STRUCTURES IMPACTED AND ENVELOPED BY AVALANCHES,
Boeing Co., Seattle, WA.
R. R. Pedersen, J. D. Dent, and T. E. Lang.
Journal of Glaciology, Vol 22, No 88, p 529-534, 1979. 5 Fig, 4 Ref, 1 Append.

Descriptors: *Avalanches, *Loads(Forces), *Structures, *Model studies, *Snow management, Forecasting, Compute models, Snow, Velocity, Methodology, Analytica techniques, Analysis, Shear, Load distribution, Flow, Pressure, Impact forces.

A computer code was reported that models two-dimensional flow of a snow-avalanche cross-section over a down-slope structure of arbitrary cross-sectional shape. Impact forces and pressure are predicted, and the flow pattern past the structure may be arrayed pictorially. The model was applied to the prediction of forces on rectangular obstacles that are of fractional height to the nominal avalanche flow depth for avalanche flow speeds up to 20 m/s. The program was applied to modeling an experiment by Salm of impact of snow blocks upon a slope-normal wall in order to demonstrate the accuracy of the code in comparison to impact-force histories measured by Salm. Difference between the experimental results and the computer simulation was less than 21%, and supporting discussion was given on factors that may account for the difference. (Humphreys-ISWS)
W80-06101

TIME-SERIES MODELLING OF AVALANCHE ACTIVITY FROM METEOROLOGICAL DATA,
National Research Council of Canada, Vancouver (British Columbia). Div. of Buiilding Research.
A. A. Salway.
Journal of Glaciology, Vol 22, No 88, p 513-528, 1979. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Avalanches, *Snow management, *Model studies, *Forecasting, Time series analysis, On-site investigations, Mathematical models, Meteorological data, Analytical techniques, Statistical methods, Hazards, *British Columbia, *Rogers Pass(B.C.).

Avalanche-hazard evaluation by field analysts is largely achieved along causal intuitive lines depending for its success upon the experience of the analyst in his particular area. Several attempts have been made in the past to quantify such procedures by means of statistical models based upon meteorological measurements. Modified forms of a multivariate technique known as linear discriminant analysis have been tried with only partial success. Intercorrelated variables and autocorrelated data, omission of time-lagged terms, insufficient variation in the dependent variable, and sampling difficulties may have combined to weaken the discriminant approach. These problems and the nature of the phenomenon suggest that a stochastic transfer-function time-series approach may be a useful alternative method. A numerical weighting scheme has been devised for the representation of avalanche activity for the Rogers Pass area of British Columbia in terms of terminus, size, and moisture-content codes for each event. From various types of correlation analysis performed on data for the period 1965-73, models were developed using the 'best' weighting scheme for avalanche activity representation and the most promising meteorological variables as indicated by the results of the correlation analysis. These relatively simple models demonstrated a good fit to the actual data in both a descriptive and a simulated-forecasting situation. (Humphreys-ISWS)
W80-06102

EVALUATION OF JET-ROOF GEOMETRY FOR SNOW-CORNICE CONTROL,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
K. L. Dawson, and T. E. Lang.
Journal of Glaciology, Vol 22, No 88, p 503-511, 1979. 8 Fig, 1 Tab, 9 Ref.

Descriptors: *Snow cornice, *Snow management, *Model studies, *Slope protection, Flow around objects, Snow, Shape, Jets, Mathematical models, Slopes, Mountains, Distribution, Spatial distribution, Scour, Flow, Hydrodynamics, Eddies, Analytical techniques, Jet-roof geometry, Snow deposition, Mountain ridges.

Numerical hydrodynamic simulation of the jet-roof geometry for control of snow deposition to prevent cornice formation at mountain ridges was reported. Different jet-roof geometries were evaluated based upon the extent and size of the ground-surface stagnation region and the recirculation region to the lee of the roof. Results show that jet-roof length should be of the same order as nominal height of the roof from the ground surface. Efficient placement of the roof was shown to be that with the leading edge directly above the mountain ridge, and roof angle approximately equal to lee slope angle. In numerical simulation of flow-field start-up, near steady-state flow is approched in less than 1.0 s real time indicating short transient-flow duration. (Humphreys-ISWS)
W80-06103

AN ANALYSIS OF THE IN-SITU RESISTIVITY OF SEA ICE IN TERMS OF ITS MICROSTRUCTURE,
National Research Council, Ottawa (Ontario). Div. of Mechanical Engineering.
G. W. Timco.
Journal of Glaciology, Vol 22, No 88, p 461-471, 1979. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Ice, *Resistivity, *Sea ice, *Electrical properties, On-site tests, Direct currents, Sounding, Physical properties, Analytical techniques, Analysis, On-site investigations, Measurement, Structure, Anisotropy, Isotropy, *In-situ resistivity, Geoelectric soundings, Microstructure, Brine cells.

The results of 66 Schlumberger geoelectric soundings on first-year sea ice were analyzed to obtain average values of d.c. electrical resistivity both parallel rho sub 1 and perpendicular rho sub p to the long brine cell direction. This analysis yielded rho sub 1 = 104 omega m, 80 omega m, 45 omega m, and rho sub p = 298 omega m, 230 omega m, 129 omega m for brine volumes v sub b of 0.040, 0.067, and 0.082, respectively. The observed dependence of rho sub 1 on v sub b is used in conjunction with a mixing formula for the electrical resistivity of a two-phase heterogeneous system to arrive at values of 'average' brine cell lengths l for relatively warm sea ice. This treatment yields l about 1.7 cm for 0.040 less than or equal to v sub b less than or equal to 0.070 with a rapid extension of brine cell lengths for brine volumes above c. 0.070. (Humphreys-ISWS)
W80-06104

2D. Evaporation and Transpiration

MAPPING POTENTIAL EVAPOTRANSPIRATION IN HILLY TERRAIN,
Natal Univ., Pietermaritzburg (South Afria.)
R. E. Schulze.
South African Geographical Journal, Vol 57 No 1, p 26-35, 1975. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Evapotranspiration, *Solar radiation, *Energy buget, *Climatology, *Topography, Terrain analysis, Mapping, Slopes, Transpiration loss, Hydrologic cycle, Watersheds(Basins), Grasslands, Spatial distribution, Seasonal, Computers, Mathematical studies, Data processing, Summer, Autum, Winter, *South Africa.

The relationsip between solar energy exposure of sloping terrain and the water loss due to evapotranspiration is discussed. Map of the potential exapotranspiration (PE) of four of the hydrological research catchments at Cathedral Peak, South Africa, were developed using climatological data collected during midsummer, midseason, and midwinter. Daily potential evapotranspiration was only about 8 mm during midsummer (December 22) and it differed only slightly with the value of daily incoming radiation. The shaded western slopes indicated lower potential water losses. Midseason (March 22) maps show greater exposure and water loss (7 mm) on the steeper western slopes and the effects of north/south sloping are very pronounced. Discrepancies between the radiation and PE (between 3 to 5 mm) were evident during midwinter (June 21). The intercatchment variations depend on the north/south sloping, Berg Wind conditions, and clould cover. In summer the Catchments vary in PE by only 5.8% in the equinoxes, 16.9%, and in midwinter by 42.5%. These data can be used to develop programs to minimize water loss by evapotranspiration and reduce South Africa's large water budget. (Sidney-IPA)
W80-06069

2E. Streamflow and Runoff

FLOOD OF JULY 5-7, 1978, ON THE SOUTH FORK ZUMBRO RIVER AT ROCHESTER, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
V. J. Latkovich.
Available from OFSS, Box 25425, Fed. Ctr. Denver, CO. 80225. Paper copy $3.50, microfiche $0.50. Geological Survey open-file report 79-1583 (WRI), 1979. 1 Sheet, 4 Fig, 2 Ref.

Descriptors: *Floods, *River flow, *Minnesota, *Thunderstorms, *Peak discharge, Flash floods, Flood damage, Flood recurrence interval, Flood frequency, Historic floods, Flood data, Aerial photography, *South Fork Zumbro River(MN), *Richester(MN).

The intense thunderstorm of July 5-6, 1978, caused record flooding on the South Fork Zumbro River at Rochester, Minnesota. The peak discharge on July 6 was 30,500 cubic feet per second compared with 19,600 cubic feet per second for the flood of March 1965, which was the largest previously known. The 1965 flood had a recurrence interval of about 30 years, whereas the 1978 flood had a recurrence interval exceeding 100 years. The flood waters claimed at least 5 lives and 5,000 people were forced to leave their homes. Millions of dollars in flood damage was reported, and this report summarizes some of the flood data and a photomosaic map shows the inundated area. (Kosco-USGS)
W80-06053

REGIONAL FLOOD-FREQUENCY RELATIONS FOR WEST CENTRAL FLORIDA,
Geological Survey, Tallahasse, FL. Water Resources Div.
M. A. Seijo, R. F. Giovannelli, and J. F. Turner, Jr.
Available from the OFSS Box 25425, Fed. Ctr. Denver Co 80225, paper copy $9.75, microfiche $4.50. Geological Survey open-file report 79-1293 (WRI), 1979, 41 p, 7 Fig, 7 Tab, 28 Ref.

Descriptors: *Flood frequency, *Florida, *Regional analysis, *Streamflow, *Flood forecasting, Flood profiles, Flood recurrence interval, Peak discharge, Watersheds(Basins), Drainage area, Regression analysis, Methodology, Hydrologic data, *West-central Florida.

This report presents regional relations for estimating the magnitude and frequency of floods on streams in west-central Florida. Flood prediction equations derived cover 20, 5-, 25-, 100-, 200-, and 500-year recurrence intervals. Annual floods for three geographic areas of west-central Florida were found to relate significantly to basin characteristics. Basin characteristics include drainage area, soils index, slope, and lake area. The average standard error of estimate for regional flood relations ranged from 38.4 to 52.1 percent with a mean of 43.5 percent. The average multiple correlation coefficient if 0.94. Regional relations apply to gaged and ungaged sites whose drainage areas are greater than 10 but less than 2,500 square miles. Tables of maximum known floods for 64 streamflow stations used in the analysis are included. Tables comparing station, weighted, and regional flood-peak discharges are also included. (Kosco-USGS)
W80-06064

THE RESPONSE OF ILLINOIS MUNICIPAL WATER SYSTEMS TO A PROLONGED PERIOD OF DROUGHT,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. C. van Es, L. C. Keasler, and R. L. Whittenbarger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204563, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center University of Illinois Research Report 152. June 1980, 82 p, 1 Fig, 20 Tab, Append. OWRT A-090-ILL(1). 14-31-0001-8015.

Descriptors: *Water shortage, *Droughts, *Municipal water, *Illinois, Water management(Applied), Water supply, Local planning, Urban water management, Illinois municipal water systems.

The research evaluates the impact of the 1976-77 extended periods of shortage of rainfall on Illinois municipal systems. Excluded from the analysis were water systems in the suburban areas of large metropolitan cities. The data were obtained through questionnaires sent to the mayors and water systems operators. The questionnaires were followed by phone and personal interviews in some cases. The survey indicates that prior to the drought those municipalities affected by it were more likely to have smaller water systems, show a smaller margin between daily rated capacity and maximum daily usage, and rely more heavily on surface water sources. There is no evidence that the municipalities which subsequently experienced the drought were significantly and systematically less well managed than the municipalities which did not experience the drought. Municipalities affected by the drought made efforts to increase the supply of available water and decrease demands for available water. Few municipalities succeeded in obtaining water from other sources; it was either too expensive or unavailable. Those municipalities which were not directly affected by the drought made very few changes in the way their water systems operate. Municipalities affected by the drought, however, frequently made changes in the water system operations which continued in effect beyond the end of the drought and which, in some cases, were not instituted until after the drought had subsided.
W80-06079

STABLE ALLUVIAL CANAL DESIGN,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY5, Proceedings Paper 15420, p 873-891, May 1980. 11 Fig, 1 Tab, 20 Ref, 2 Append.

Descriptors: *Canals, *Channels, *Sedimentation, Sediment transport, Computer models, Regime, River flow, Hydraulics, Alluvial channels, Canal design, Model studies, Alluvial canals, Stable canals.

The hypothesis of minimum stream power for stable alluvial channels was used to derive a condition for alluvial channels in equilibrium. A method incorporating this condition with a flow-resistance formula and a sediment-discharge formula was developed to compute the width, depth, and slope of stable alluvial channels for a given set of water and sediment discharges. Applying this method yielded a design chart that provides the stable width and depth of alluvial canals with trapezoidal shape for a given set of water discharge, channel slope, sediment size, and side slope. Comparing data from some regime canals and small experimental canals showed good agreement between the observed data and analytical predictions. (Lee-ISWS)
W80-06129

RUNOFF SYNTHESIS USING LANDSAT AND SCS MODEL,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. M. Ragan, and T. J. Jackson.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY5, Proceedings Paper 15387, p 667-678, May 1980. 2 Fig, 7 Tab, 9 Ref, 2 Append.

Descriptors: *Hydrology, *Model studies, *Urban runoff, *Remote sensing, Surface waters, Runoff, Land use, Urbanization, Data collections, *Runoff synthesis, Landsat, SCS model, Landsat digital data.

The land cover requirements of the Soil Conservation Service (SCS) model used to develop volume of runoff for hydrograph synthesis in suburban areas were modified to be compatible with Landsat digital data. Curve numbers obtained with these alternate land cover categories compared well with those obtained in published example problems using conventional categories. Synthetic flood frequency relationships computed for a test watershed showed that the conventional approach based on aerial photos agreed well with the Landsat-based approach to land cover determination. (Lee-ISWS)
W80-06131

STOCHASTIC PARAMETER ESTIMATION PROCEDURES FOR HYDROLOGIC RAINFALL-RUNOFF MODELS: CORROLATED AND HETEROSCEDASTIC ERROR CASES,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W80-06138

A STOCHASTIC-CONCEPTUAL ANALYSIS OF RAINFALL-RUNOFF PROCESSES ON A HILLSLOPE,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
R. A. Freeze.
Water Resources Research, Vol 16, No 2, p 391-408, April 1980. 18 Fig, 3 Tab, 37 Ref.

Descriptors: *Rainfall, *Runoff, *Slopes, *Model studies, Mathematical models, Stochastic processes, Monte Carlo method, Hydraulic properties, Hydraulic conductivity, Rainfall-runoff relationships, Precipitation(Atmospheric), Overland flow, Infiltration, Hydraulics, Hydrology, Analytical techniques, Hillslopes, Runoff processes, Hydrologic processes.

A stochastic-conceptual mathematical model of hydrologic processes on a hillslope was utilized to investigate the influence of the spatial stochastic properties of the hillslope parameters on the statistical properties of the resulting runoff events. The model utilized a stochastic rainfall generator and allowed the generation of overland flow by both the Horton mechanism and the Dunne mechanism. Streamflow statistics were determined on the basis

of an event-based Monte Carlo simulation. The simulated hillslope runoff events were individually and statisticaliy representative of actual runoff events reported in the literature from experimental watersheds. Results indicated that each of the parameters representing the spatial stochastic properties of the hydraulic conductivity distribution on a hillslope exerts an important influence on the statistical properties of runoff events arising from a hillslope under a given climatic regime. The mean value is the most important parameter; the standard deviation is quite important; the autocorrelation function is the least important. If one tries to represent a heterogeneous hillslope by an 'equivalent' homogeneous hillslope, the statistical properties of the predicted runoff generated from a given stochastic sequence of storm events may be greatly in error. Results of the simulations reported in this paper suggest that the distribution of hydraulic conductivities over a watershed should be included in parametric representations of the unit hydrograph, in conceptual predictions of flood exceedance probabilities, and in physically based assessments of the autocorrelation structure of the streamflow sequences. Results of this study also infer a close relationship between climate, hydraulic conductivity, and geomorphic landform development. (Sims-ISWS)
W80-06140

OPTIMAL OPERATION OF MULTIRESERVOIR POWER SYSTEMS WITH STOCHASTIC INFLOWS,
Institut de Recherce de l'Hydro-Quebec, Varennes.
A. Turgeon.
Water Resources Research, Vol 16, No 2, p 275-283, April 1980. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Reservoir operation, *Optimization, *Hydroelectric power, *Model studies, Mathematical models, Stochastic processes, Powerplants, Peak power, Electric power demand, Reservoirs, Storage, Inflow, Rivers, Simulation analysis, Hydrology, Lakes, Multireservoir systems.

The optimization of the weekly operating policy of multireservoir hydroelectric power systems is a stochastic nonlinear programing problem. For small systems this problem can be solved by dynamic programing, but for large systems there is yet no method of solving this problem directly so that one must resort to mathematical manipulations in order to solve it. This paper presented and compared two possible manipulation methods for solving this problem. The first, called the one-at-a-time method, consists in breaking up the original multivariable problem into a series of one-state variable subproblems that are solved by dynamic programing. The final result is an optimal local feedback operating policy for each reservoir. The second method, called the aggregation/decomposition method, consists in breaking up the original n-state variable stochastic optimization problem into n stochastic optimization subproblems of two-state variables that are also solved by dynamic programing. The final result is a suboptimal global feedback operating policy for the system of n reservoirs. The two methods were then applied to a network of six reservoir-hydroplant complexes, and the results obtained were reported. It was shown that the suboptimal global feedback operating policy gives better results than the optimal local feedback operating policy. (Sims-ISWS)
W80-06146

ON THE STATISTICAL CHARACTERISTICS OF DROUGHT EVENTS,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 2B.
W80-06147

ON THE DEFINITION OF DROUGHTS,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 2B.
W80-06148

A FREQUENCY DISTRIBUTION FOR ANNUAL FLOODS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton.
Water Resources Research, Vol 16, No 2, p 347-354, April 1980. 8 Fig, 7 Tab, 6 Ref.

Descriptors: *Frequency analysis, *Floods, *Australia, *Distribution patterns, Frequency, Statistical methods, Annual flood, Statistics, Parametric hydrology, *Eastern Australia, Logarithms, Three-parameter distributions, Catchments, Frequency factor, Recurrence interval, Data sets, Gumbel distribution.

A distribution for frequency analysis of the logarithms of annual floods was derived from data for 78 catchments in eastern Australia. The statistical data from these catchments demonstrated the need for three-parameter distributions instead of two-parameter distributions for analysis of annual floods. A nonlinear relationship between frequency factor and function of recurrence interval was demonstrated, and this relationship was used as the basis for the distribution. Methods of fitting the distribution to data sets, including sets that contain zero values, were described. A comparison was made of results from the new distribution, the log Pearson type 3, the log normal, the log Gumbel, and the Gumbel distribution. (Roberts-ISWS)
W80-06152

UNSTEADY ONE-DIMENSIONAL FLOW OVER A PLANE: PARTIAL EQUILIBRIUM AND RECESSION HYDROGRAPHS,
Institute of Hydrology, Wallingford (England).
E. M. Morris, and D. A. Woolhiser.
Water Resources Research, Vol 16, No 2, p 355-360, April 1980. 6 Fig, 4 Ref.

Descriptors: *Shallow water, *Overland flow, *Model studies, Mathematical models, Hydrographs, Unsteady flow, Surface waters, Runoff, Equations, Theoretical analysis.

This paper presented a comparison of solutions of the shallow water (Saint Venant) equations for unsteady one-dimensional flow over a plane and solutions of the diffusion and kinematic wave equations, which were approximate forms of the Saint Venant equations. In the cases studied, the lateral inflow was constant and positive but may cease before a steady state flow is reached. It was shown that for highly subcritical flow, the criterion proposed by Woolhiser and Liggett was necessary but not sufficient to enable a choice between the shallow water equations and the kinematic approximation. An additional criterion was proposed for these cases. (Sims-ISWS)
W80-06153

EFFECT OF TAIL BEHAVIOR ASSUMPTIONS ON FLOOD PREDICTIONS,
Colorado State Univ., Fort Collins.
H. W. Shen, M. C. Bryson, and I. D. Ochoa.
Water Resources Research, Vol 16, No 2, p 361-364, April 1980. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Flood forecasting, *Design flood, *Model studies, Mathematical models, Flood frequency, Hydrologic data, Frequency, Analytical techniques, Temporal distribution, Flow, Streamflow, Floods, Hydrology.

Two of the distributions most widely used in flood magnitude modeling are the Gumbel type 1 extreme-value distribution and the log Pearson type 3. These represent two fundamentally different assumptions about distribution tail behavior in that extreme events from the log Pearson type 3 distribution follow the Gumbel type 2 extremal distribution. This paper compared these two assumptions by comparing flood predictions by the type 1 and type 2 models. For the Gumbel type 1 distribution the ratio of x sub n sub 1, the magnitude of a flood with a return period n sub 1, to x sub n sub 2, the magnitude for a shorter return period n sub 2, can be estimated by an upper bound that is ln n sub 1/ ln n sub 2. It was shown that the ratio of x sub n sub 1/x sub n sub 2 from the type 2 distribution is always greater than that from the type 1, approximated by (n sub 1/n sub 2) to the 1/k power. An analysis of flow data collected in the United States indicated that in the majority of cases the best fitting type 2 distribution does not have a finite variance and often not even a finite mean. The impact of this on statistical data analysis was discussed. (Sims-ISWS)
W80-06154

FLOODING PROBLEMS IN A SMALL URBAN WATERSHED--DOAN BROOK, CLEVELAND, OHIO,
Dalton-Dalton-Newport, Shaker Heights, OH.
S. J. Nacht.
Water Resources Bulletin, Vol 16, No 3, p 401-407, June 1980, 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Floods, *Urban runoff, *Urban hydrology, *Ohio, Watersheds(Basins), Streamflow, Rainfall, Precipitation(Atmospheric), Drainage, Flood control, Hydrology, Hydraulics, *Cleveland(OH).

Analysis of a small urban watershed's flooding was undertaken to determine causes and solutions to this serious environmenal hazard affecting University Circle, the cultural heart of Greater Cleveland. Doan Brook is a small, highly distrubed urban stream draining 11.3 square miles. Much of the stream corridor and associated park land is owned by the public. The upper watershed lies in the communities of Shaker Heights and Cleveland Heights who lease parkland from Cleveland. Two 50-year floods seriously affected the Circle area in August 1 million in damages. These events resulted from excessive rainfall triggering rapid earth movement of valley walls in the upper watershed, decreased basin lag time from the infilling of several small upland lakes, a seriously undersized stream channel and storm culvert (at University Circle), and complex institutional arrangements between the three communities in the watershed. Suggestions were presented for a methodology to resolve the technical aspects of the flooding problem. (Sims-ISWS)
W80-06182

BIOMECHANICS OF VEGETATIVE CHANNEL LININGS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
N. Kouwen, and R-M. Li.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15464, p 1085-1103, June 1980. 4 Fig, 2 Tab, 31 Ref, 2 Append. EPA R805457-01.

Descriptors: *Open channel flow, *Vegetation effects, *Roughness(Hydraulic), Retardance, Hydraulics, Flow resistance, Flow, Vegetation, Friction, Mannings equation, Darcy-Weisbach equation, *Biomechanics, Vegetative channel linings.

A method to determine and apply the biomechanical properties of vegetative channel linings was presented. The method was used to evaluate the stiffness of vegetation commonly used to protect earth channels from erosion. Using the vegetation stiffness and stem length, the deflected height of the channel lining was predicted to yield a relative roughness under given flow conditions. The relative roughness was used to calculate a value of the Darcy-Weisbach friction factor or Manning's n. A method to design a vegetated channel was included. (Lee-ISWS)
W80-06191

2F. Groundwater

A FIELD EXERCISE ON GROUND WATER FLOW USING SEEPAGE METERS AND MINI-PIEZOMETERS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W80-06014

REGIONAL GROUND WATER FLOW NEAR A HIGH-LEVEL RADIOACTIVE WASTE REPOSITORY,
Dames and Moore, Los Angeles, CA.
A. K. Runchal, and T. Maini.
Dames and Moore Engineering Bulletin 50, p 11-20, December, 1979. 10 Fig, 1 Tab, 14 Ref.

Descriptors: *Radioactive waste disposal, *Ground water movement, *Regional analysis, *Flow system, Flow rates, Aquifer characteristics, Bedrock, Crystalline rock, Convection, Radioisotopes.

Deep underground burial in stable geologic formation may be the most economical, technically feasible, and safest alternative for disposal of high-level radioactive waste. This paper examines the problem of reliably defining the hydrogeologic properties of a rock mass and predicting thermally induced regional ground water flow. An equivalent porous media approach was used to estimate transit time for radionuclides to reach the biosphere. For a generic granite repository, a thermal loading of 100 kw/acre alters the regional horizontal flow in to a convection cell pattern near the repository. This reduces the transit time for radioactive nuclides to reach near-surface aquifers and the biosphere. The transit time may be as little as 40 years at the time of maximum influence (between 1000 and 4000 years after repository decommissioning). However, the total amount of flow through the repository is only on the order of one gallon per minute for the investigated range of hydrogeologic properties and repository scenarios. Parametric simulations indicate that this flow is largely controlled by thermal-loading. Changes in ground water flow rates caused by local variations in hydrogeologic properties, water table slopes, or boundary conditions are rather small. However, regional changes of hydrogeologic properties greatly influence flow patterns and flow rates. (Purdin-NWWA)
W80-06018

EVALUATION OF INDUCED INFILTRATION BETWEEN THE RIVER SKERNE AND THE MAGNESIAN LIMESTONE IN SOUTH EAST DURHAM,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W80-06020

SINGULARITIES IN DARCY FLOW THROUGH POROUS MEDIA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
O. E. Lafe, J. S. Montes, A. H. O. Cheng, J. A. Liggett, and P. L-F. Liu.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY6, p 977-997, June, 1980. 19 Fig, 1 Tab, 9 Ref, 3 Append.

Descriptors: *Darcy's Law, *Potential flow, *Porous media, Ground water movement, Numerical analysis, Laplaces Equation, Singularities, Boundary processes, Cutoff walls, Interzonal flow, Permeability sinks, Water wells, Flow around objects.

Numerical analysis of potential flow often ignores singularities by assuming that the error will be localized in the vicinity of the singularity. Singularities occurring in problems of elasticity have been calculated by using superposition in which the regular and singular parts of the solution are separated with the singular part being represented analytically as finite series with undetermined coefficients. In this paper, the Boundary Integral Equation Method (BIEM) is used to solve for the regular part with extra boundary nodes close to the singularity in order to provide enough equations for the determination of the unknown coefficients. The use of 'singular elements', where the interpolating function has same behavior as an analytical solution near a singularity, is explored. Singularities considered are: corner flow over a cutoff; interzonal flow between zones of different permeability; and the case of sources and/or sinks in the medium. The latter type of singularity is important in ground water problems with recharge and pumping wells. (Purdin-NWWA)
W80-06021

FLUID FLOW IN NATURALLY FRACTURED RESERVOIRS,
Rice Univ., Houston, TX. Dept. of Geology.
T. D. Streltsava-Adams.
In: 2nd Invitational Well-Testing Symposium Proceedings, October 25-27, 1978, Berkeley, California, Lawrence Berkeley Laboratory, University of California, Berkeley, p 71-77. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Fracture permeability, *Flow, *Model studies, Aquifers, Drawdown, Aquifer tests, Compaction, Porosity, Fractures(Geologic).

Analyses of naturally fractured reservoir rocks show that overall permeability is increased due to high fracture permeability. The diversity in fracture pattern and fracture-matrix properties is seen in reservoir performance which displays a variety of responses to an induced pressure change. These include the s-shaped transient pressure type, the homogeneous reservoir type, the two-asymptotic lines type, the reverse distance-drawdown type, etc. A double porosity fluid flow model is presented in which the medium is assumed to consist of randomly distributed fractures breaking up the matrix into porous blocks of irregular size and shape. A general approach for developing a fluid flow model is considered first. The pressure drawdown is then presented for fractures and matrix. Reservoir behavior may be uniquely interpreted only if the reservoir properties are known independently. Changes in rock properties during production is of particular importance in analyzing reservoir performance. A combined drawdown and buildup test may give an insight into the compaction response of a formation. Multi-well pressure interference tests and core data may also help eliminate uncertainties in interpreting the diversive behavior of fractured formations. (Purdin-NWWA)
W80-06024

DEPTH CONSTRAINTS ON THERMAL STORAGE WELLS,
Houston Univ., TX.
For primary bibliographic entry see Field 8B.
W80-06025

EFFECTS OF KARST AND GEOLOGIC STRUCTURE ON THE CIRCULATION OF WATER AND PERMEABILITY IN CARBONATE AQUIFERS,
Geological Survey, Reston, VA.
V. T. Springfield, J. R. Rapp, and R. B. Anders.
Journal of Hydrology, Vol 43, No 1/4, p 313-332, October, 1979. 3 Fig, 66 Ref.

Descriptors: *Karst hydrology, *Structural geology, *Ground water movement, *Permeability, *Carbonate rocks, Karst, Sinks, Water circulation, Flow systems, Fractures(Geologic), Solubility, Joints(Geologic), Folds(Geologic), Faults(Geologic), Aquifers, Specific yield.

Karstification results from the dissolution and leaching of carbonates, evaporites and other soluble rocks. Karst features are classified as: (1) surficial features that do not extend far below the surface; and (2) features such as sinkholes that extend below the surface and affect water circulation. The permeability of highly productive carbonate aquifers is due chiefly to enlargement of fractures and other openings by water circulation. Depth of circulation depends on the difference in elevation between recharge and discharge areas. Important factors in the development of karst and permeability in carbonate aquifers include: climate; topography; solubility of the rocks; geologic structure; ground water circulation; base level; and the surface conditions under which the rocks are first exposed to meteoric water. In compact carbonate rocks, joints, fractures, and bedding planes are essential for the development of a circulation system. Where rocks are not horizontal, water may move parallel to the dip. On breached anticlines, water may move parallel to the strike. Faults may restrict the lateral movement of water or serve as channels for deep circulation. Three types of karst aquifers are described based on yield. The aquifers with the largest yields include five of the most productive in the U.S.A. (Purdin-NWWA)
W80-06027

MAJOR GEOCHEMICAL PROCESSES IN THE EVOLUTION OF CARBONATE-AQUIFER SYSTEMS,
Geological Survey, Reston, VA.
B. B. Hanshaw, and W. Back.
Journal of Hydrology, Vol 43, No 1/4, p 287-312, October, 1979. 10 Fig, 13 Ref.

Descriptors: *Aquifer systems, *Carbonate rocks, *Geochemistry, Permeability, Porosity, Mineralogy, Water chemistry, Ground water, Diagenesis, Mass transfer, Calcite, Dolomite, Sand aquifers, Mud, Reefs, Computer models, Sedimentation, Petrology.

This paper examines geochemical processes in carbonate aquifer formation and transformation. Permeability and porosity of carbonate aquifers vary greatly due to mode and environment of deposition and high reactivity of carbonate minerals. Ground water chemistry is controlled by recrystallization, dolomitization, cementation, structural activity, dissolution and reprecipitation of minerals during ground water movement, and mass transfer of chemical species. Aragonite, calcite and dolomite have a major influence on ground water chemistry. Most carbonate aquifers composed of sand-size materials have high initial porosity. Carbonate rocks deposited as fine-grained muds have extremely low permeability that requires fracturing and dissolution to develop into aquifers. Most sand beds and reefs are good aquifers. Porosity and permeability can be changed by selective dissolution, inversion of aragonite to calcite, recrystallization, and dolomitization. Predictive models developed by mass-transfer and chemical equilibrium calculations demonstrate the controlling reactions in aquifer systems. To fully understand the functioning of a carbonate aquifer system requires knowledge of: head distribution, porosity, permeability and chemistry of ground water; boundary conditions; tectonic history; and the sedimentologic and mineralogic framework. As predictive chemical models become more widespread, the expertise of carbonate petrologists and geochemists will become increasingly integrated in the hydrologists' studies of ground water systems. (Purdin-NWWA)
W80-06031

GROUND WATER SIMULATION USING A ONE DIMENSIONAL FLOW MODEL,
Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W80-06044

MAPS SHOWING GROUND-WATER CONDITIONS IN THE HOPI AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA--1977,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06052

GENERALIZED CONFIGURATION OF THE BOTTOM OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahasses, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06054

GENERALIZED THICKNESS OF THE CONFINING BED OVERLYING THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.

W80-06055

CLASSIFICATION OF GROUND-WATER RECHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-06056

WATER QUALITY OF FLORIDA SPRINGS,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 1A.
W80-06058

GEOHYDROLOGIC DATA FOR THE LOWER WOOD RIVER GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06068

FLOW NET FOR UNSATURATED INFILTRATION FROM PERIODIC STRIP SOURCES,
Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering and Architecture.
For primary bibliographic entry see Field 2G.
W80-06089

SEEPAGE VS. TERRACE DENSITY IN RECLAIMED MINELAND SOIL,
North Dakota State Univ., Fargo. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W80-06107

A STATISTICAL APPROACH TO THE INVERSE PROBLEM OF AQUIFER HYDROLOGY, 3. IMPROVED SOLUTION METHOD AND ADDED PERSPECTIVE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Water Resources Research, Vol 16, No 2, p 331-346, April 1980. 6 Fig, 2 Tab, 18 Ref, 5 Append.

Descriptors: *Groundwater, *Aquifers, *Model studies, Mathematical models, Statistics, Statistical models, Transmissivity, Groundwater movement, Water levels, Finite element analysis, Theoretical analysis, Hydrology, Inverse problem.

Paper 1 of this sequence presented a new statistically based approach to the problem of estimating spatially varying aquifer transmissivities on the basis of steady water level and flux data. Paper 2 described a case study in which the new method had been applied to actual field data from the Cortaro Basin in southern Arizona. The purpose of paper 3 was to introduce a new efficient method of solution that works under a much wider range of conditions than the method employed in papers 1 and 2. The new method was based on a variational theory developed by Chavent, which was extended to the case of generalized nonlinear least squares. The method was implemented numerically by a finite element scheme. The inverse problem was posed in terms of log transmissivities instead of transmissivities and was solved by a Fletcher-Reeves conjugate gradient algorithm in conjunction with Newton's method for determining the step size to be taken at each iteration. The method does not require computing sensitivity coefficients, and one may therefore expect it to result in considerable savings of both computer storage and computer time. Posing the problem in terms of log transmissivities was shown to have important advantages over the traditional approach, not the least of which is guaranteeing that the computed transmissivities will always be positive. The paper included a theoretical analysis of the effect that various errors corrupting the data and the model may have on the final log transmissivity estimates. (Sims-ISWS)
W80-06130

A NOTE ON THE MEANING OF STORAGE COEFFICIENT,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan, and B. Y. Kanehiro.
Water Resources Research, Vol 16, No 2, p 423-429, April 1980. 1 Tab, 14 Ref. DOE W-7405-ENG-48.

Descriptors: *Groundwater, *Storage coefficient, *Model studies, *Mathematical models, Aquifers, Storage, Unsteady flow, Porous media, Porosity, Pore pressure, Theoretical analysis, Equations, Theis equation, Hydrology.

The term storage coefficient and the related expressions, storativity, specific storage, and total compressibility, are frequently used in hydrogeology, petroleum engineering, and other fields. These parameters seek to express the quantity of water required to be added to or removed from storage in order to change (under conditions of drainage) the average hydraulic head or pore pressure of a porous material by a given amount. Originally introduced over 4 decades ago, the storage parameter is still used by many in the restricted sense of a coefficient occurring in the partial differential equation describing fully saturated flow. However, with the significant increase in our computational abilities using powerful numerical integration techniques, there presently exists a need to have a more fundamental appreciation of the storage parameter as it relates to transient fluid flow in porous media. Such a fundamental approach requires consideration of the type of loading to which the porous medium is subject as well as certain conventions followed by various workers in actually defining the parameter. While no new derivations or results were presented, this paper attempted to assemble in a single place the various ideas relevant to the storage parameter in order to obtain a generalized perspective. (Sims-ISWS)
W80-06139

THE TRANSPORT OF A RADIOACTIVE SALT THROUGH A SEMI-INFINITE COLUMN OF POROUS MEDIUM: A PHYSICAL MODEL,
California Univ. Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 5B.
W80-06141

THE EFFECT OF SOIL ACTIVITY ON THE CHEMISTRY OF CARBONATE GROUNDWATERS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W80-06142

ON JACOB'S APPROXIMATION IN FLOW THROUGH POROUS MEDIA,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
S. R. Singh, and B. Sagar.
Water Resources Research, Vol 16, No 2, p 377-380, April 1980. 1 Fig, 10 Ref.

Descriptors: *Groundwater, *Porous media, *Drawdown, *Mathematical models, Model studies, Approximation method, Analytical techniques, Equations, Flow, Groundwater movement, Fluid mechanics, Aquifers, Wells, Water wells, Oil wells, Hydraulics, Well hydraulics.

The equation of flow of slightly compressible fluids through nondeformable, or consolidating, porous media is a nonlinear parabolic partial differential equation of the second order. Hitherto, the equation has been approximately linearized by neglecting its nonlinear term. This method of linearization, hereafter called Jacob's method, was first introduced by C.E. Jacob for flow of groundwater in confined aquifers. In this article the method of functional transformation was used to find a transformation that exactly linearized the equation. A problem of constant drawdown well in extensive homogeneous and isotropic consolidating, or nondeformable, porous media was solved. Solution of the approximately linearized differential equation for the aforesaid problem was compared with the exact one, and the error due to the neglect of the nonlinear term was analyzed. It was shown that the error resulting from Jacob's approximate method of linearization for flow of water through confined aquifers is negligible. However, in the case of the transport of other compressible fluids through nondeformable formations the error is not insignificant. (Sims-ISWS)
W80-06143

MASS TRANSPORT: 1. A STOCHASTIC ANALYSIS OF MACROSCOPIC DISPERSION,
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
L. Smith, and F. W. Schwartz.
Water Resources Research, Vol 16, No 2, p 303-313, April 1980. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Dispersion, *Mass transfer, *Groundwater, *Porous media, *Model studies, Mathematical models, Groundwater movement, Diffusion, Hydraulic conductivity, Porosity, Tracers, Stochastic processes, Analytical techniques, Macroscopic dispersion.

Conventional modeling of mass transport in groundwater systems usually involves use of the dispersion-convection equation with large values of porous medium dispersivity to account for macroscopic dispersion. This work described a modeling concept that accounts for macroscopic dispersion not as a large-scale diffusion process but as mixing caused by spatial heterogeneities in hydraulic conductivity. The two-dimensional spatially autocorrelated hydraulic conductivity field was generated as a first-order nearest-neighbor stochastic process. Analysis of a variety of hypothetical media showed that over finite domains a population of tracer particles convected through this statistically homogeneous conductivity field does not have the normal distribution and does not yield the constant dispersivity that classic theory would predict. This problem occurs because of insufficient spatial averaging in the macroscopic velocity field by the moving tracer particles. Our analyses suggested that the diffusion model for macroscopic dispersion may be inadequate to describe mass transport in geologic units. Sensitivity analysis with the model has shown that features of transport, such as first arrival of a tracer, are dependent on porous medium structure and that even when the statistical features of porous media are known, considerable uncertainty in the model result can be expected. (Sims-ISWS)
W80-06149

THERMOHALINE INSTABILITY IN ANISOTROPIC POROUS MEDIA,
Oslo Univ. (Norway). Dept. of Mathematics.
P. A. Tyvand.
Water Resources Research, Vol 16, No 2, p 325-330, April 1980. 3 Fig, 12 Ref, 1 Append.

Descriptors: *Groundwater, *Porous media, *Salts, *Temperature, *Model studies, Mathematical models, Convection, Groundwater movement, Chemical precipitation, Anisotropy, Stability, Water pollution, Pollutants, Thermohaline, Salt fingers.

The onset of thermohaline convection in a horizontal porous layer was investigated theoretically. The layer was homogeneous, anisotropic, and of infinite horizontal extent. Horizontal isotropy with respect to permeability, thermal diffusivity, and solute diffusivity was assumed. For porous media with thermally insulating solid matrices the stability diagram has the same shape as in the case of isotropy. The critical wave number is constant and equal to that of the one-component case. For thermally conducting matrices, new features may occur; the locus of the direct mode in the stability diagram may not be a straight line, and the corresponding wave number may be nonconstant. The initiation of salt fingers was studied by linear theory. It seems that the width of salt fingers is influenced by anisotropy in the diffusivities. Anisotropy may or may not favor salt fingers, depending on a dimensionless diffusion parameter D being greater than or less than 1. (Sims-ISWS)

W80-06151

STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W80-06199

2G. Water In Soils

DYNAMIC SYSTEM FOR MEASURING SOIL-MOISTURE CHARACTERISTICS AT VARIOUS TEMPERATURES,
Wisconsin Univ.-Madison.
J. R. Nimmo, E. E. Miller, and W. R. Gardner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204670, Price Codes: A03 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin, Madison, Technical Report WIS WRC 80-11, 1980. 33 p, 16 Fig, 1 Tab, 9 REf. OWRT A-072-WIS(1),134-00071-05;1434-0001-7106;14-34-0001-8053.

Descriptors: *Richards apparatus, *Soil moisture, *Moisture content, Soil temperature, *Temperature, *Tensiometers, *Water measurement, Soil moisture waters.

Many methods have been devised for measuring soil moisture characteristics, but few have yield complete characteristics--i.e., sets of values for all three properties for wetting, drying, and intermediate-reveral (scanning-curve) conditions. The isotemal moisture charactristics of soiis are considerably more difficult to measure for 'real' soils than for glass-bead media. The objective of this work was to utilize modern technical developments for performing these measurements. In addition, the measurements of characteristics were repeated at several temperatures. A system developed at the University of Wisconsin-Madison for performing these measurements is described.
W80-06077

APPLICATION OF RECENT RESULTS IN FUNCTIONAL ANALYSIS TO THE PROBLEM OF WETTING FRONTS,
Cold Regions Reseqrch and Engineering Laboratory, Hanover, NH.
Y. Nakano.
Water Resources Research, Vol 16, No 2, p 314-318, April 1980. 16 Ref, 1 Append.

Descriptors: *Wetting, *Porous mdia, *Mathematical models, Equations, Darcys law, Infiltration, Theoretical analysis, Mathematical studies, *Functional analysis, *Wetting fronts, *Singular surfaces.

Traditionally in hydrology and soil physics, wetting fronts appearing in porous media described by Darcy's law have not generally been considered to be singular surfaces. Some recent results from functional analysis were presented as evidence supporting the viwpoint that wetting fronts with a finite propagating speed generally are singular surfaces. (Visocky-ISWS)
W80-06088

FLOW NET FOR UNSATURATED INFILTRATION FROM PERIODIC STRIP SOURCES,
Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering and Architecture.
V. Batu.
Water Resources Research, Vol 16, No 2, p 284-288, April 1980. 5 Fig, 15 Ref.

Descriptors: *Flow nets, *Infiltration, *Unsaturated flow, *Mathematical models, Water table aquifers, Groundwater movement, Equations, Irrigation, Model studies, Steady flow, Depth, Stream functions.

Using unsaturated flow theory, authors have obtained general equations of the stream functions for a variable infiltration rate over periodic strip sources located on the soil surface. In this paper solutions were obtained for the water table located at infinite and finite depths. The steady state unsaturated flow equation, linearized using the Kirchhoff transformation based on the exponential relationship between the unsaturated hydraulic conductivity and soil water pressure, was solved with the Fourier analysis technique. The solutions for equally spaced strip sources were obtained with the constant infiltration rate as a special case. As another special case, an approximate result for infinite water table depth was obtained for an array of equally spaced line sources which was first obtained by Raats (1970). Using the matric flux potential distribution for the infinite water table depth (Batu, 1978), the author presented flow nets for equally spaced strip sources. The stream functions corresponding to the saturated flow cases were also obtained. Comparisons between the saturated and unsaturated streamlines were made, and it was concluded that the discrepancies between the two are larger with decreasing matric flux potential in the flow field. These solutions are of interest in connection with sprinkler and furrow irrigation. Other than these uses, the results may be used for different purposes in civil and agricultural engineering applications. (See also W71-00558, W79-00471) (Visocky-ISWS)
W80-06089

SEEPAGE VS. TERRACE DENSITY IN RECLAIMED MINELAND SOIL,
North Dakota State Univ., Fargo. Dept. of Agronomy.
L. Prunty, and D. Kirkham.
Journal of Environmental Quality, Vol 9, No 2, p 273-278, April-June 1980. 5 Fig, 1 Tab, 10 Ref. SEA-EPA 684-15-2.

Descriptors: *Seepage, *Infiltration, *Saturated flow, *Mathematical models, Model studies, Pollutants, Path of pollutants, Leacing, Mine wastes, Terracing, Groundwater movement, Soil water movement, Flow, Potential flow, Topography, Reclaimed strip mines.

The seepage pattern of infiltrated water through hillside mine overburden materials is of concern because of the possible pollution hazard presented by leachates. In this paper detailed seepage patterns as found by Gram-Schmidt analysis were presented for: (1) a uniform-slope topography, (2) a four-terrace topography, and (3) a one-terrace topography. The aspect ratio (depth/width of the mine pit) of 1:40 and average slope of 5% were the same for each topography and correspond approximately to the aspect ratio and slope of an actual research coal mine. The volume of overburden was also the same for each topography. Saturation of the overburden was assumed. The results, therefore, depicted the maximum possible seepage condition for each topography, not average or normally expected conditions. A plot of the total relative seepage rate as a function of the reciprocal of the terrace density (number of terraces) was presented. The total seepage rate for the four-terrace topography was 10 times greater than for the uniform-slope topography. (Sims-ISWS)
W80-06107

FIELD HETEROGENEITY: SOME BASIC ISSUES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research, Vol 16, No 2, p 443-448, April 1980. 4 Fig, 37 Ref.

Descriptors: *On-site investigations, *Theoretical analysis, *Soil water movement, *Model studies, *Heterogeneity, Soil physics, Stochastic processes, Absorption, Infiltration, Soils, Mathematical studies, Unsaturated flow, Soil texture, Deterministic heterogeneity, Stochastic heterogeneity.

Present-day soil-water physics enables useful quantitative predictions in the laboratory and in simple field situations. Difficulties, however, frequently arise for areas of appreciable size in the field. Known and unknown heterogeneities, on many scales, may vitiate predictions based on theory for homogeneous, or very simple heterogeneous, systems. Some aspects of unsaturated and generally unsteady flow in heterogeneous systems were reviewed: the mathematical nature of the flow equation, the concept of scale-heterogeneity, analytical and quasi-analytical solutions. The enormity of the total problem of unsaturated unsteady flows in stochastic heterogeneous systems was illustrated through a dialectic of eight successive stages of simplification. The concept of the autocorrelation function governing lambda, the internal characteristic length, was introduced; and the problem was posed in terms involving the distribution and autocorrelation functions of lambda, the reduced potential and conductivity functions, and the initial and boundary conditions as the data, from which it is required to establish distribution functions of various descriptors of the flow. The solution to a grossly simplified example of horizontal absorption was presented. Mean apparent sorptivity decreases rapidly to about one-fifth of the mean (and about half the minimum) sorptivity of the component soils. Variation about the mean is very great but decreases as absorption proceeds. (Visocky-ISWS)
W80-06137

THE TRANSPORT OF A RADIOACTIVE SALT THROUGH A SEMI-INFINITE COLUMN OF POROUS MEDIUM: A PHYSICAL MODEL,
California Univ. Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 5B.
W80-06141

NUMERICAL ANALYSIS OF INFILTRATION INTO A SAND PROFILE BOUNDED BY A CAPILLARY FRINGE,
New South Wales Univ., Kensington (Australia); and Royal Military Coll., Duntroon (New Zealand).
A. A. Curtis, and K. K. Watson.
Water Resources Research, Vol 16, No 2, p 365-371, April 1980. 12 Fig, 14 Ref.

Descriptors: *Infiltration, *Capillary fringe, *Numerical analysis, *Model studies, Mathematical models, Drainage, Tile drainage, Air, Soils, Air-water interfaces, Pressure, Soil water, Soil water movement, Irrigation, Moisture content, Sand profiles.

The rapid response sometimes observed in a tile drain system following surface ponding of water was discussed in terms of the air compressibility effect. An earlier numerical study describing water movement into a bounded profile with a lower boundary impermeable to the passage of both air and water was reviewed with particular reference to the validity of the time-dependent boundary condition transformation used in simulating the inhibiting effects of the air pressure increase on infiltration. The extension of the transformation approach to a profile bounded by a capillary fringe was then considered in detail, and the results of numerical analyses were presented for infiltration into two columns of a fine sand initially in hydraulic equilibrium from a prior gravity drainage regime. The shorter column developed a steady state flow condition at short times which was consistent with earlier experimental findings. In contrast, the pressure of the entrapped air in the longer column gradually increased as infiltration proceeded until the analysis was terminated when air excape through the lower boundary was imminent. (Sims-ISWS)
W80-06155

AN AUTOMATED SYSTEM FOR MEASURING SOIL WATER POTENTIAL GRADIENTS IN A RHIZOTRON SOIL PROFILE,
Science and Education Administration, Auburn, AL.
F. L. Long, and M. G. Huck.
Soil Science, Vol 129, No 5, p 305-310, May 1980. 2 Fig, 24 Ref.

Descriptors: oil moisture, Moisture content, Root zone, Rhizosphere, Soil profiles, Soils, Agriculture.

A family of soil water potential curves, nearly continuous with time, is necessary to calculate soil

water movement in the soil profile. Frequent personal reading to obtain such curves is both time consuming and costly. A system was described that automatically measures soil water potential in a soil-root environment in rhizotron studies. The system utilizes automatically operated fluid switch wafers that are capable of switching as many as 24 tensionmeters to a single pressure transducer for measurement. The tranducer is sufficiently sensitive to measure differences as small as 0.003 bar easily. With frequent automatic readings and tensiometers placed at various soil depths, the data are recorded on magnetic tape by a data-acquisition system from which they go to a plotter where a essentially continuous water potential curve of a soil profile is obtained. (Sims-ISWS)
W80-06185

THE EFFECT OF MOISTURE ON PHOSPHORUS DIFFUSION IN COAL MINE SPOILS,
North Dakota Univ., Grand Forks. Dept. of Physics.
For primary bibliographic entry see Field 5C.
W80-06186

ANALYTICAL-NUMERICAL COMPUTATION OF INFILTRATION,
Florida Univ., Gainesville. Dept. of Civil Engineering.
A. D. Koussis, and S-L. Chow.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15494, p 123-134, June 1980. 2 Fig, 15 Ref, 2 Append.

Descriptors: *Infiltration, *Porous media, *Model studies, Mathematical models, Analytical techniques, Irrigation, Soils, Soil water, Soil water movement, Unsaturated flow, Gravity, Moisture content, Diffusion, Sorption, Hydrology.

An approximate, analytical-numerical solution was developed for one-dimensional, vertical infiltration of water into soil. The soil diffusivity was assumed to vary either exponentially or as a power law; however, other analytical formulations can also be accommodated. The solution was physically based, involving parameters related to the soil properties, and is valid for 'short times' of infiltration. Its center piece was a simple, rapid, and sufficiently accurate solution for the sorption process. This solution was of the similarity type, and the moisture gradient was given in analytical form. The remaining integration of the initial value problem was performed numerically to obtain the moisture distribution. Comparisons with exact numerical solutions were used to test the accuracy of the solution. The influence of gravity was accounted for approximately, following Philip's theory, by an additive series term that was determined numerically from the integration of a linear ordinary differential equation. Sorptivity was expressed completely analytically thus providing a simple, and physically rational, algebraic relationship for the cumulative infiltrated volume and the infiltration rate. (Sims-ISWS)
W80-06196

DRAIN DEPTH AND SUBIRRIGATION IN LAYERED SOILS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W80-06197

WATER RETENTION MEASUREMENT FOR SOILS,
Feng Chia Coll. of Engineering and Business, Taichung (Taiwan). Dept. of Hydrology Engineering.
C. Su, and R. H. Brooks.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15483, p 105-112, June 1980. 3 Fig, 7 Ref, 1 Append.

Descriptors: *Soil water, *Retention, *Drainage, *Laboratory tests, Instrumentation, Measurement, Equipment, Water storage, Groundwater, Wetting, Drying, Pressure, Soil pressure, Pore pressure, Soil science, Agricultural engineering, Water retention measurement.

A method for rapidly obtaining water retention data for soils was presented. A variation of the Richard's pressure cell was used in which equilibrium at a particular water content was achieved by adjustment of the outflow pressure, rather than by permitting equilibrium to be reached at a fixed increment of water pressure. On the wetting cycle, water was added directly to the sample rather than being imbibed through the capillary barrier. The result was that data on both wetting and drying cycles can be obtained in a small fraction of the time needed for conventional procedures. Consistent data that fit on a smooth curve have been obtained. The results were thought to be comparable to those determined by the Richard's procedure except, possibly, in a range of water contents greater than that at which an interconnected air phase exists. (Sims-ISWS)
W80-06198

PROFILE SOIL MOISTURE FROM SURFACE MEASUREMENTS,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15474, p 81-92, June 1980. 5 Fig, 1 Tab, 6 Ref, 1 Append.

Descriptors: *Soil moisture, *Soil profiles, *Remote sensing, *Model studies, Mathematical models, Simulation analysis, Soil moisture meters, Soil physical properties, Soil physics, Soil properties, Moisture content, Soil water, Hydraulic conductivity, Infiltration, Soil science.

A method was presented for predicting the volumetric soil moisture of the soil profile from the surface layer soil moisture measurement and information on the soil properties of the profile under bare soil conditions. This method was based upon soil physics relationships and the assumption of hydraulic potential equilibrium throughout the profile. This procedure was tested using data generated with a soil-moisture simulation model for a variety of situations involving bare soils. Results indicated that this procedure can be used to predict profile soil moisture within acceptable error bounds under some conditions. However, the surface layer measurements should be made during predawn period. The optimal surface layer thickness inferred from the analyses was about 0.1 m (4 in.). These results provide some guidelines for developing remote sensing methods for soil-moisture determination. (Sims-ISWS)
W80-06200

2H. Lakes

OPTIMUM SPILLWAY BREADTH FOR GRAVITY DAMS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. M. Townson.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY3, Proceedings Paper 15254, p 409-422, March 1980. 10 Fig, 1 Tab, 7 Ref, 2 Append.

Descriptors: *Dams, *Spillways, *Flood control, *Storage, Dam design, Gravity dams, Costs, Economics, Routing, Numerical analysis, Overflow, Reservoirs, *Spillway breadth, Gradient search technique, Overflow spillways.

The provision of overflow capacity in an impounding reservoir may occupy a large fraction of the total project cost. With a higher cost per unit volume than elsewhere in the dam, an optimum spillway flow breadth exists that minimizes total cost. This optimum was explored for simple gravity dams both under the restriction of negligible storage and with finite storage using level pool routing combined with a gradient search technique. It was found to be a sensitive product of cost ratio, peak inflow, and duration. A dimensionless treatment of the quantities involved made possible the comparison of four widely different dams, three constructed in the United States and one in the United Kingdom. All were found to have spillway breadths close to the optimum. Since small variations from the optimum may result in cost increases that are large in absolute terms, the concept appears useful as a datum for economic assessments at feasibility stage. (Singh-ISWS)
W80-06097

WINDPOWER TIME SERIS ABOVE A TEMPERATE LAKE,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Limnology and Oceanography, Vol 25, No 3, p513-528, May 1980. 10 Fig, 5 Tab, 52 Ref.

Descriptors: +Lakes, *Winds, +Wisconsin, *Model studies, *Limnology, Time series analysis, Analytical techniques, Analysis, Temperate, On-site data collections, Data collections, Mathematical models, Histograms, Profiles, Wind velocity, Drag, Flow characteristis, Computer models, Energy, *Lake Mendota(WI), Windpower.

A computer model of windpower flux was developed for lake Mendota, Madison, Wisconsin, Based on 3-h wind speeds and estimates of above-lake bulk Richardson number. The model then was applied to the period 1 April-31 october (1966-1975). Fifteen years (1962-1976) of hourly records were also analyzed for Simcoe, Ontario (Lake Erie Basin). Expected power varies diurnally during all seasons, in phase with, or lagging slightly behind the solar cycle. The diel amplitude is about 46% of the expected daily mean. At both Simcoe and Madison, the expected daily power above an ice-free lake attains a broad maximum of 1,200,000-1,400,000 ergs/sq cm/d in winter and early spring, drops sharply in late April, and shows a broad summer minimum of 300,000-400,000 ergs/sq cm/d insolation show evidences of periodicity of about 7 days, probably related to synopti-scale cold front passages. Following the front, with its characteristic wind directional shift from SSW to NNW, a characteristic calm develops accompanied by intense solar radiation. The spring power histogram features a mdian value about half of the mean, because of the high probability of observing very low windpower coupld with a very long tail on the frequency distribution. Low power also shows a strong clustering tendency in spring because of both the strong inversion conditions in that season and the period of about 7 days in the synoptic-scale weather shifts. (Humphreys-ISWS)
W80-06112

CHARACTERIZATION OF ORGANIC NITROGEN IN NATURAL WATERS: ITS MOLECULAR SIZE, PROTEIN CONTENT, AND INTERACTIONS WITH HEAVY METALS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. R. Tuschall, Jr., and P. L. Brezonik.
Limnology and Oceanography, Vol 25, No 3, p 495-504, May 1980. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Organic compounds, *Nitrogen, *Lakes, *Florida, Freshwater, Water quality, Heavy metals, Organic matter, Amino acids, Algae, Proteins, Laboratory tests, Methodology, Analysis, Sampling, Analytical techniques, Data collections,Copper, *Lake Apopka(FL), *Lake Weir(FL).

The nitrogenous organic matter from two freshwater lakes and from the filtrate of a unialgal culture of Anabaena sp. was characterized chemically and evaluated for metal complexation ability. Proteinaceous matter was isolated from acidified samples by cellulose cation exchange columns and eluted with a basic salt solution. Isolated proteinaceous matter accounted for 14-34% of the original dissolved organic nitrogen. Gel permeation chromatography and ultrafiltration methods used to separate dissolved organic nitrogen into various size fractions yielded differing results, but most of the organic nitrogen had apparent molecular weights between 10,000 and 50,000 daltons. The copper-complexing capacity of the proteinaceous

matter was determined by differential pulse anodic stripping voltammetry. Conditional stability constants, which represent the mixed stability of all nonlabile ligands in the sample, ranged from 1,600,000 to 1.3 x 10 to the 7th power for the three samples. (Humphreys-ISWS)
W80-06114

STRATIFICATION OF AEROBIC METHANE-OXIDIZING ORGANISMS IN LAKE MENDOTA, MADISON, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
S. M. Harrits, and R. S. Hanson.
Limnology and Oceanography, Vol 25, No 3, p 412-421, May 1980. 3 Fig, 5 Tab, 19 Ref. NSF BMS 75-14012.

Descriptors: *Lakes, *Methane bacteria, *Aerobic bacteria, *Stratification, *Wisconsin, Dissolved oxygen, On-site investigations, Microorganisms, Spatial distribution, Profiles, Nitrogen, Water temperature, Laboratory tests, Methodology, Analysis, Data collections, Water sampling, Ecology, Aquatic bacteria, *Lake Mendota(WI).

The microflora responsible for methane oxidation are stratified in a narrow band in the thermocline of Lake Mendota where dissolved oxygen is low during summer. Oxygen sensitivity of growth of these organisms or of methane oxidation cannot account for their absence from the epilimnion because oxygen does not inhibit either process under in situ conditions at concentrations exceeding those measured in natural samples. The dissolved inorganic nitrogen content of samples where methane oxidation rates were highest was greater than 1 mg/liter in summer 1977. The authors could not obtain evidence of in situ nitrogen fixation although enrichment cultures grew on nitrogen-free media and fixed 15N2. Nitrite was present at the position in the water column of maximum methane oxidation; this suggests that methanotrophic bacteria co-oxidized ammonia. The distribution of methanotrophs in the lake indicated that their position in the water column at each time of year was determined by the concentration profiles of oxygen and methane. Methane oxidation in summer depletes the methane in the epilimnion, and the absence of oxygen in the hypolimnion precludes growth of the organisms there. At other times of year the rates of oxidation of methane seem to be determined by the concentration of methane in the water. The rate of oxidation of methane by a sample was increased by additional methane when the in situ concentration was less than 5 microM. (Humphreys-ISWS)
W80-06116

SIZE-SELECTIVE PREDATION, LIGHT TRANSMISSION, AND OXYGEN STRATIFICATION: EVIDENCE FROM THE RECENT SEDIMENTS OF MANIPULATED LAKES,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
J. A. Kitchell, and J. F. Kitchell.
Limnology and Oceanography, Vol 25, No 3, p 389-402, May 1980. 8 Fig, 1 Tab, 56 Ref. NSF DEB-7911781.

Descriptors: *Lakes, *Limnology, *Euphotic zone, *Predation, Lake sediments, On-site investigations, Oxygen, Stratification, Daphnia, Zooplankton, Aquatic life, Size, Dissolved oxygen, Water temperature, On-site data collections.

In an experiment maintained since 1951, half of a divided lake was limed resulting in a significantly expanded euphotic zone. In both basins native fish were removed and rainbow trout introduced. Quantitative analysis of zooplankton remains preserved in the sediments of both lakes provides evidence of the selectivity of a visually dependent predator at natural and enhanced transparency and oxygen concentrations. The sediment record effectively documents the known manipulations and the expected responses. In the control lake, no significant changes in zooplankton species composition, species dominance, or size-frequency distribution are recorded. In the alkalized lake, a succession in zooplankton dominance from Daphnia pulex to Daphnia rosea to Bosmina is recorded, as is a reciprocal change in mean size of D. pulex and D. rosea. The relative position of the thermocline with respect to the oxygen minimum barrier and the light transmission curve accounts for the observed differences in selective predation intensity. By verifying the sensitivity of the sediment record to the results of known manipulations, the authors have presented evidence of a technique equivalent to long term experiments. (Humphreys-ISWS)
W80-06118

FLUORESCENCE: ABSORBANCE RATIOS--A MOLECULAR-WEIGHT TRACER OF DISSOLVED ORGANIC MATTER,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
For primary bibliographic entry see Field 5B.
W80-06134

THE EFFECTS OF TRANSECT DIRECTION ON OBSERVED SPATIAL PATTERNS OF CHLOROPHYLL IN LAKE TAHOE,
California Univ., Davis. Div. of Environmental Studies.
M. R. Abbott, T. M. Powell, and P. J. Richerson.
Limnology and Oceanography, Vol 25, No 3, p 534-537, May 1980. 3 Fig, 22 Ref. NSF DEB76-20341, DEB76-11095.

Descriptors: *Lakes, *Water quality, *Chlorophyll, On-site investigations, Spatial distribution, Water sampling, Surveys, Measurement, Methodology, Analysis, Fluorescence, Data collections, Water chemistry, *Lake Tahoe(CA NV).

Horizontal transects of fluorescence measurements have been used extensively to investigate phytoplankton patchiness. Variance spectra were calculated from these data, thus quantifying spatial heterogeneity as a function of length scale. Analysis of such field-work and associated theoretical investigations is based on the assumption that horizontal patchiness is isotropic. Three transects done in Lake Tahoe (California-Nevada) in different directions on the same day resulted in variance spectra that were significantly different from each other. The possibility of windrows appears consistent with the spectra. Although the exact cause of the differences was unclear, the results do violate the assumption of isotropic horizontal phytoplankton patterns. (Humphreys-ISWS)
W80-06135

A VARIANCE-CONSTRAINED RESERVOIR CONTROL PROBLEM,
IBM Thomas J. Watson Research Center, Yorktown Heights, NY.
M. Sniedovich.
Water Resources Research, Vol 16, No 2, p 271-274, April 1980. 4 Tab, 7 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Water management(Applied), *Model studies, Mathematical models, Equations, Mathematics, Storage, Discharge(Water), Inflow, Hydrology.

A dynamic programing solution procedure was developed for a class of variance-constrained reservoir control problems. The variance constraint was incorporated as a penalty term in a nonseparable Lagrangian problem that is solved by a two-stage procedure. First, the difficulty associated with the nonseparability of the problem was resolved by the consideration of a modified simpler separable problem that was solved by a simple additive dynamic programing recursion. Then the optimal solution to the nonseparable problem was found by a simple research algorithm. The entire discussion was devoted to the mathematical aspects of the problem, and no consideration was given to the applicability of variance constraints as far as water resources management problems are concerned. The procedure was applied to a simple numerical example. (Sims-ISWS)
W80-06145

OPTIMAL OPERATION OF MULTIRESERVOIR POWER SYSTEMS WITH STOCHASTIC INFLOWS,
Institut de Recherce de l'Hydro-Quebec, Varennes.
For primary bibliographic entry see Field 2E.
W80-06146

THE ENTRAINMENT OF COHESIVE SEDIMENTS IN FRESHWATER,
Aerospace Corp., Los Angeles, CA.
For primary bibliographic entry see Field 2J.
W80-06187

MEAN SUMMER CIRCULATION IN LAKE ONTARIO WITHIN THE COASTAL ZONE,
Woods Hole Oceanographic Institution, MA.
G. T. Csanady, and J. T. Scott.
Journal of Geophysical Reseearch, Vol 85 No C5, p 2797-2812, May 20, 1089. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Water circultion, *Summer, *Lake Ontario, *Model studies, Mathematical models, Coasts, Lakes, Circulation, Currents(Water), Velocity, Temperature, Water temperature, Sampling, On-site investigations, Advection, Heat transfer, Momentum transfer, Limnology, Coastal circulation.

Arithmetic averages of daily temperature and current surveys during July-August 1972 were used to define a mean summer costal circulation pattern in Lake Ontario. Some of the important features of this mean flow pattern may be explained by simple equilibrium models of wind-driven flow. Discrepancies between these models and coastal zone observations appear to be due mainly to advection of momentum during transient flow episodes, especially those involving the intermittent appearance of full upwelling along the north shore. The south shore flow pattern consists of divegent coastal jets, much as the theoretical steady response of a frictionless two-layer basin to an eastward wind. At the eastern end of the lake a deep current is generated by interface friction below the strong coastal jets. Along the north shore there is no mean coastal jet pattern, and the return flow of warm water must be supposed to be accomplished some distance offshore. (Sims-ISWS)
W80-06188

OCCURRENCE OF A DEEP NITRITE MAXIMUM IN LAKE MICHIGAN,
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.
J. A. Mortonson, and A. S. Brooks.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 1025-1027, June 1980. 1 Fig, 15 Ref.

Descriptors: *Lake Michigan, *Nitrities, *Phkytoplankton, Nitrogen, Nitrogen compounds, Chlorophyll, Dissolved oxygen, Temperature, Water temperature, Ammonia, Lakes, Sampling, Data processing, Limnology, Nitrite maxima.

A nitrite maximum with concentrtions up to 10 micrograms NO2(-)-N/L was observed at depths between 30 and 60 m during summer in oxygen-saturated waters of Lake Michigan. The extracellular release of nitrite by phytoplankton concentrated below the thermocline appears to account for this maximum. In fall, when phytoplankton were not longer concentrated in this zone, no nitrite maximum was observed. It appears that the deep nitrite maximum in Lake Michigan is found only in association with high densities of phytoplankton. (Sims-ISWS)
W80-06189

2I. Water In Plants

NITROGEN FIXATION ASSOCIATED WITH FOUR SPECIES OF SUBMERGED ANGLOSPERMS IN THE CENTRAL CHESAPEAKE BAY,
Maryland Univ., College Park. Dept. of Botany.
F. Lipschulta, J. J. Cunningham, and J. C. Stevenson.
Estuarine and Coastal Marine Science Vol 9, p 813-818, 1979. OWRT-A-042-MD(1), 14-34-0001-

8022.

Descriptors: *Nitrogen fixation, *Angiosperms, *Chesapeake Bay, *Sounds(NC), Nutrients, Ecosystems, Myriophyllum spicatum, Potamogeton perfoliatus, Ruppia maritima maritima, Eldodea canadensis, Aquatic plants, *Submerged plants.

The rate of acetylene reduction was determined for Myriophyllum spicatum, Potamogeton perfoliatus, Ruppia maritima and Eldodea canadensis, in a brackish water tributary of Chesapeake Bay. Ruppia had the highest nitrogen fixation rate on a dry weight basis (66 ng-at. N(g wt h)-1). However the fixation per square meter of creek bottom was highest (16 3 microg-at. N(sq. m H)-1) for Myriophyllum due to its greater biomass. Generally, our low rates are more comparable to those associated with seagrasses in North Carolina, than to many higher rates reported from tropical waters. We postulate that low nitrogen fixation rates are a consequence of the availability of nitrogen either in the water column or sediments of temperate estuaries such as the Chesapeake Bay, and the North Carolina Sounds.
W80-06040

NET REAINFALL AND INTERCEPTION LOSS IN A SAVANNA COVER (NETTO REENVAL EN ONDERSKEPPINGSVERLIES IN 'N SAVANNABEDEKKING),
Durban-Westville Univ. (South Africa)
G. du T. De Villiers.
South African Geographer (Dennesig Stellenbosch), Vol 5, No 6, p 465-475, 1977. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Rainfall intensity, *Interception, *Canopy, *Stemflow, *Evaporation, Water loss, Distribution patterns, Vegetatin effects, Forests, Trees, Grasses, Raindrops, Rain gages, Correlation analysis, Regression analysis, Frequency analysis, Variability, Semiarid climates, *South Africa.

The amount of precipitation reaching the ground under a canopy of vegetation is different from the amount measured in the open. The loss of water by the interception of rain by forest vegetation was investigated in a semi-arid area and the parameters affecting interception were determined. Regression analysis and variance analysis were carried out on the data from the experimental zone and a linear relationship between the total amount of precipitation falling on th forest vegetation and the stemflow was found. interception loss was concluded to be a function of vegetation density per surface area and evalporation probabilities. (Sidney-IPA)
W80-06091

2J. Erosion and Sedimentation

A NUMERICAL MODEL FOR COMPUTATION OF SEDIMENTATION IN LAKES AND RESERVOIRS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
F. Karim, T. E. Croley, II, and J. F. Kennedy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204456, Price codes: A18 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Iowa State University, Ames. Completion Report No 105, (1979). 409 p. OWRT A-068-IA(1), 14-34-0001-8017.

Descriptors: *Numerical model, *Sedimentation, *Lakes, *Reservoirs, Sediment, Entrapment, Particle size, Sediment distribution, Compaction, Elevation-area-capacity, Simulation analysis, Prediction, Forecasting, Operation plans, Reservoir type curves, Coralville Lake(IA), Red Rock Lake(IA), Saylorville Lake(IA), Iowa, Computer model SEDRES.

A new computer-based numerical model, SEDRES, is developed for the calculation of amounts, rates, and spatial distributions of sediment in lakes and reservoirs. The principal components of SEDRES compute the following: sediment entrapment, distribution, and differential settling for three different size classes (clay, silt and sand); compaction of currently and all previously deposited sediments; correction to zero elevation for compaction; sediment slump correction due to compaction at zero elevation and at sediment-type interfaces; alteration of elevation-area-capacity relation due to sedimentation. Inputs to the model are water inflows, reservoir operation levels, original reservoir elevation-area- capacity relation, sediment characteristics, type of sediment-entrapment and sediment-distributin methods. The time-interval for simulation may be one week or any multiple thereof. SEDRES was applied to predict future sedimentation rates in the Coralville, the Red Rock and the Saylorville Lakes on the Des Moines River, Iowa. Model results were in good agreement with the observed data. Results from the 100-year sedimentation simulatin of these three reservoirs are presented at 5-year intervals for the current and several alternative operation plans.
W80-06012

DISSOLVED OXYGEN IN INTRAGRAVEL WATER OF THREE TRIBUTARIES TO REDWOOD CREEK, HUMBOLDT COUNTY, CALIFORNIA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W80-06066

DETERMINATION OF CERIUM IN MARINE SEDIMENTS,
Bhabha Atomic Research Centre, Bombay (India).
For primary bibliographic entry see Field 5A.
W80-06086

BEDFORM SPACING AND FLOW RESISTANE,
Canterbury Univ., Christchurch (New Zealand). Dept. of Agriculatural Engineering.
T. R. H. Davies.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY3, Proccedins paper 15258, p 423-433, march 1980. 3 Fig, 1 Tab, 25 Ref, 2 Append.

Descriptors: *Dunes, *Erosion, *Flow resistane, *Sedimentation, Alluvial channels, Hydraulics, Laboratory tests, Channels, Channel morphology, Rivers, Flow resistance, *Bedforms, Bed ripples, Maximum resistance principle.

The resistance to flow in an alluvial channel depends mainly on the size, shape, and spacing of the bedforms present, and these in turn depend on the flow depth and velocity. A hypothesis is postulated that the nonplanar equilibrium shape of a deformable boundary is that which causes a local maximum of resistane to flow. It is based on the data describing the geometry of stream meanders and of self-formed armored beds, and on figures for the resistane to flow past rectangular rigid roughness elements in channels. Laboratory experimens were made to test the maximum resistane hypothesis. The resuls showed that the spacing/height ratio at which bedforms of a given shape develop maximum resistance to flow corresponds to the spacing/height ratio at which such bedforms occur when formed naturally by the flow of water over sand. The maximum resistane principle, by relating bedform geometry to flow conditions, offers some progress towards understanding the complex interaction between bedforms and flow resistance. (Singh-ISWS)
W80-06096

EVALUATION OF JET-ROOF GEOMETRY FOR SNOW-CORNICE CONTROL,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 2C.
W80-06103

FRACTIONATION OF SEDIMENT OXYGEN DEMAND,
Illinois State Water Survey, Peoria.
For primary bibliographic entry see Field 5A.
W80-06125

LABORATORY MEASUREMENT OF SEDIMENT BY TURBIDITY,
Western Canada Hydraulic Labs. Ltd. (British Columbia).
P. R. B. Ward, and R. Chikwanha.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15470, p 1041-1053, June 1980. 5 Fig, 3 Tab, 6 Ref, 2 Append.

Descriptors: *Channels, *Sedimentation, *Instrumentation, *Measurement, Clays, Erosion, Floods, Suspended load, Hydrology, Water pollution, Turbidity, *Channel stabilization, Sediment deposits, Suspended sediment.

A low cost light transmission instrument was used to measure the concentration of suspended sediment in river water samples. Problems that have confronted previous workers such as the fast reduction of instrument sensitivity with grain size of sediment were investigated, and the method was shown to be viable. Good performance with acceptable accuracies and very short measuring times were shown to apply for samples in the concentration range 100 mg/L to 2000 mg/L. Sand-sized particles were not measured with the laboratory instrument, although clay- and silt-sized particles were measured satisfactorily. A method was described of correcting the results for particles that were not measured, applicable to rivers that carry only small proportions of suspended sand. The method was described and tested for laboratory application only, but the findings of the 'Calibration' section may be applied also to field instruments that work on the turbidity principle. (Lee-ISWS)
W80-06127

A SAMPLER FOR COHESIVE SEDIMENT IN THE BENTHIC BOUNDARY LAYER,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 7B.
W80-06132

A SPATIALLY RESPONSIVE HYDROLOGIC MODEL TO PREDICT EROSION AND SEDIMENT TRANSPORT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
B. B. Ross, V. O. Shanholtz, and D. N. Contractor.
Water Resources Bulletin, Vol 16, No 3, p 538-545, June 1980. 2 Fig, 3 Tab, 37 Ref. OWRT A-077-VA(7) and A-083-VA(1).

Descriptors: *Sediment transport, *Forecasting, *Computer models, *Finite element analysis, Overland flow, Channel flow, Runoff, Sediments, Land use, Sediment yield.

A finite element numerical model has been developed by the authors which routes overland and channeled flows in a watershed, given soils, land use, topographic descriptors, and rainfall as input. Such processes as infiltration, canopy interception, seasonal growth of vegetation, and depression storage are described in the hydrologic context of the model. These capabilities, along with the spatial detail and responsiveness of the model, allow a ready adaptation of the model to provide for the prediction of sediment transport and yield. It is assumed that the best results can be obtained by a technique which utilizes the following procedures. Sediment yield to the channel is described by functions describing soil detachment by rainfall and overland flow and transport by overland flow. Since the model description of the channel flow processes involves a more realistic representation of the physical drainage system, an attempt was made to define sediment transport in the channel by erosion and sedimentation mechanics. A conceptual framework is provided whereby the integrated effects of various land use activities on sediment transport and yield can be evaluated. Inherent in this provision of the model is the capability of determining the effects of any control measures to be implemented on a watershed.

W80-06159

THE ENTRAINMENT OF COHESIVE SEDIMENTS IN FRESHWATER,
Aerospace Corp., Los Angeles, CA.
M. K. Fukuda, and W. Lick.
Journal of Geophysical Research, Vol 85, No C5, p 2813-2824, May 20, 15 Fig, 3 Tab, 25 Ref.

Descriptors: *Sediments, *Sediment transport, *Entrainment, *Lake sediments, Laboratory tests, Hydraulic models, Shear stress, Velocity, Flow, Mixing, Settling velocity, Suspended solids, Dispersion, Freshwater, Limnology, Sedimentology, Cohesive sediments.

Presented in this study were experimentally measured characteristics of the entrainment rate and settling speeds of fine-grained, cohesive sediments in freshwater. The investigation focused on three different sediments of varying mineral composition which are representative of the sediments of Lake Erie. The influences of the bulk sediment water content and of the mineral and size composition on the entrainment rate and equilibrium concentration of these suspended sediments were determined. Linear increases in the bulk sediment water content resulted in logarithmic increases in the entrainment rate and equlibrium concentration. For a limited range of shear stresses near that needed to initiate noticeable entrainment the entrainment rate and equilibrium concentration increased logarithmically as the applied shear stress was increased linearly. For larger stresses, linear increases in the applied shear stress caused approximately linear increases in the entrainment rate and equilibrium concentration. At fixed values of water content and shear stress the entrainment rate and equilibrium concentration increased as the clay mineral content of the sediment increased and as the median particle size decreased. Settling speed experiments demonstrated that the median settling speed of the suspended sediment particles in a quiescent fluid increased as the ionic strength of the solution increased. At a fixed ionic strength the settling speed decreased with increased clay mineral content. (Sims-ISWS)
W80-06187

BIOMECHANICS OF VEGETATIVE CHANNEL LININGS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-06191

EROSIVITY VALUES FOR INDIVIDUAL DESIGN STORMS,
Science and Education Administration, Boise, ID.
K. R. Cooley.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15462, p 135-145, June 1980. 4 Fig, 5 Tab, 11 Ref, 2 Append.

Descriptors: *Design storm, *Erosion, *Soil erosion, Rainfall intensity, Rainfall, Conservation, Hydrology, Erosion control, Climatology, Soil conservation, Soil management, *Erosivity index, Design rainfall events, Erosivity.

A method was developed for determining the erosive power, R sub st, of individual rainfall events of any selected frequency and duration for any of the four SCS type storms. The method provides an easy, rapid procedure for assessing erosion or pollution potential on a storm basis, since sediments themselves are pollutants and are carriers of chemical pollutants. It also allows designers of conservation measures to determine the range of erosion potential that might be encountered and the most critical combination of storm type and soil or ground cover conditions. In some cases, managers could use this method to determine harvest schedules that would minimize erosion losses from the more susceptible fields. (Lee-ISWS)
W80-06195

2K. Chemical Processes

MAJOR GEOCHEMICAL PROCESSES IN THE EVOLUTION OF CARBONATE-AQUIFER SYSTEMS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W80-06031

WATER-QUALITY DATA FROM FIVE OREGON STREAM BA
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06067

THE EFFECT OF SOIL ACTIVITY ON THE CHEMISTRY OF CARBONATE GROUNDWATERS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
J. J. Drake.
Water Resources Research, Vol 16, No 2, p 381-386, April 1980. 2 Fig, 1 Tab, 32 Ref.

Descriptors: *Groundwater, *Water chemistry, *Carbonates, *Model studies, Mathematical models, Carbon dioxide, Air, Soils, Temperature, Air temperature, Respiration, Calcium, Calcite, Chemistry, Hydrology, Soil activity.

Regional variations in HCO3(-) concentrations of carbonate groundwaters were explained by the combination of a simple ecological model of soil CO2 production and a consideration of the manner in which soil water, soil air, and carbonate materials interact. Carbonate groundwaters in North America were divided into those that have evolved largely under open system conditions and those that have evolved under closed system conditions. The open system group members (with one exception) all come from high latitudes, and it was suggested that recurrent glaciations have acted to replenish soil zone carbonate materials and maintain the soil zone as an important source of dissolved carbonate minerals. (Sims-ISWS)
W80-06142

2L. Estuaries

GENETIC AND PHYSIOLOGICAL ADAPTATION OF THE COPEPOD EURYTEMORA AFFINIS TO SEASONAL TEMPERATURES,
Maryland Univ., Baltimore County, Catonsville. Dept. of Biological Sciences.
P. Bradley.
Genetics Vol 90 p 193-205, September, 1978, 5 Tab, 28 Ref. OWRT B-021-MD(3),14-34-0001-6085.

Descriptors: *Copepods, *Eurytemore affinis, Genetic variance, *Temperature tolerance, Physiological variance, Heritability, Offspring-parent regression, Chesapeake Bay.

Evidence of significant additive genetic (genic) variance in temperature tolerance of the copepod Eurytemora affinis was diverived from several sources. Differences were observed between average tolerances of progency of animals exposed and not exposed to heat shock in a power plant. Genic variance was estimated using offspring-parent regressions, full-sib, and half-sib convariances, with quite consistent results. Expressed genic variance between male progeny was always higher than that among female progeny. The pairs of estimates obtained were as follows: female heritabilities first, 0.40 plus or minus 0.09 and 0.84 plus or minus 035 (half-sibs); 0.20 plus or minus 0.09 and 0.79 plus or minus 0.24 (full-sib); 0.11 plus or minus 0.45 (full-sibs); 0.28 plus or minus 0.18 and 0.78 plus or minus 0.29 (full-sibs); 0.11 plus or minus 0.44 and 0.72 plus or minus 0.26 (offspring-parent regression). There was no evidence of either nonadditive genetic variance of common environmental (maternal and brood) effects, implying that the genetic variance was mostly additive and was not maintained because of heterozygous advantage. The presence of so much genetic variance is surprising in view of the high physiological adaptation found earlier, especially in females.
W80-06038

THE MEASUREMENT OF TEMPERATURE TOLERANCE: VERIFICATION OF AN INDEX,
Maryland Univ., Baltimore County, Baltimore. Dept. of Biological Sciences.
B. P. Bradley.
Limnology and Oceanography, Vol 21, No 4, p 596-599, July 1976. OWRT-A-027-MD(3), 14-31-0001-5020.

Descriptors: *Temperature tolerance, *Copepods, *Eurytemora affinis, Longevity, Index values, *Shock-recovery index, Bays, Estuaries.

A shock-recovery assay for temperature tolerance is demonstrated to predict survival of the copepod Eurytemora affinis at high temperature. The assay can be modified to allow comparison between widely divergent treatment groups.
W80-06041

DETERMINATION OF CERIUM IN MARINE SEDIMENTS,
Bhabha Atomic Research Centre, Bombay (India).
For primary bibliographic entry see Field 5A.
W80-06086

ORGANIC-RICH COLLOIDAL MARERIAL IN ESTUARIES AND ITS ALTERATION BY CHLORINATION,
Maryland Univ., College park. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W80-06093

THE ANNUAL CYCLE OF PLANKTON DIATOM GROWTH AND SILICA PRODUCTION IN THE INNER OSLOFJORD,
Oslo Univ. (Norway). Dept. of Marine Biology and Limnology.
E. Paasche, and I. Ostergren.
Limnology and Oceanography, Vol 25, No 3, p 481-494, May 1980. 10 Fig, 4 Tab, 36 Ref.

Descriptors: *Fjords, *Plankton, *Silica, *Diatoms, On-site investigations, Aquatic life, Sampling, Analysis, Analytical techniques, Distribution, Profiles, Nitrogen, Nitrates, Laboratory tests, Aquatic environment, Data collections, Foreign research, Productivity, *Norway, *Oslofjord(Norway), Biogenic silica.

Concentrations of amorphous particulate silica (biogenic silica) in the uppermost layer of the inner Oslofjord, Norway, varied between 2 and 324 micrograms Si/liter over a 1-year period in 1977-1978. Most of the silica was present in frustules of living or dead diatoms, but there was always a certain amount (up to about 50 micrograms Si/liter) in a form that could not be recognized under the microscope. Silica was produced mainly during three large blooms of Skeletonema costatum in February-March, May, and June. At the peak of the June bloom, there was up t 20 times more Si present as diatom silica than as dissolved orthosilicic acid. Uptake experiments in June indicated depletion times of dissolved Si as short as 3 h. Although the S. costatum cells were less heavily silicified in May and June than in February-March, they showed no morphological signs of a drastic Si shortage. (Humphreys-ISWS)
W80-06115

DISTRIBUTION OF OXYGEN IN MARINE SEDIMENTS MEASURED WITH MICROELECTRODES,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
N. P. Revsbech, J. Sorensen, T. H. Blackburn, and J. P. Lomholt.
Limnology and Oceanography, Vol 25, No 3, p 403-411, May 1980. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Dissolved oxygen analyzers, *Oxidation-reduction potential, *Sediments, *Laboratory

tests, Oxygen, Assay, Analysis, Analytical techniques, Oxidation, Cores, On-site investigations, Methodology, Sampling, Data collections, Spatial distribution, *Marine sediments, Oxygen profiles, Amperometric assay.

Membrane-covered platinum electrodes with a tip diameter of 2-8 micrometers were used for an amperometric assay of dissolved oxygen in marine sediments. The oxygen profile extended to 3-5 mm depth in nonilluminated sediment; even at high light intensities and at low temperatures it did not extend below 10-mm depth in a homogeneous sandy sediment. Oxygen profiles recorded during light-dark cycles were used to estimate the rates of oxygen production and consumption and also to calculate the apparent diffusion coefficient for oxygen in the sediment. Apparently macrofaunal activity, rather than molecular diffusion and water turbulence, was important for the occasional transport of oxygen into deeper layers and thus for the provision of oxidized conditions (positive redox potential) down to 5-10 cm below the sediment surface. (Humphreys-ISWS)
W80-06117

MIXING AND CIRCULATION IN THE NORTHWESTERN GULF OF ST. LAWRENCE: A STUDY OF A BUOYANCY-DRIVEN CURRENT SYSTEM,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
C. L. Tang.
Journal of Geophysical Research, Vol 85, No C5, p 2787-2796, May 20, 1980. 14 Fig, 1 Tab, 25 Ref, 1 Append.

Descriptors: *Mixing, *Water circulation, *Currents(Water), *St Lawrence River, Current meters, Circulation, Temperature, Salinity, Buoyancy, Spatial distribution, Gulfs, Estuaries, Sampling, Data processing, Hydrography, *Gulf of St Lawrence.

Mixing and circulation near the entrance of the St. Lawrence estuary were studied by using the hydrographic and current meter data obtained in the summer of 1978. It was found that the currents in the upper 40 m are mainly buoyancy driven. As the low salinity water from the estuary flows eastward and encounters the more saline Gulf of St. Lawrence water, a wedge-shaped layer of low salinity water and a density front are formed. Intense vertical mixing takes place along the boundary of the layer. The geostrophic current associated with the front flows southward and, upon reaching the shore, turns east. From there on it flows parallel to the coast and is reinforced by a basin-wide cyclonic gyre forming a strong coastal jet, the Gaspe current. The salinity front divides the deep water into the two flow regimes. Eastward (westward) of the front the currents in the 40- to 100-m depth are cyclonic (anticyclonic). The variability of the temperature and salinity fields was examined. The effect of the variability on the interpretation of the data was discussed. (Sims-ISWS)
W80-06122

M2 TIDAL EFFECTS IN GREATER COOK STRAIT, NEW ZEALAND,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
M. J. Bowman, A. C. Kibblewhite, and D. E. Ash.
Journal of Geophysical Research, Vol 85, No C5, p 2728-2742, May 20, 1980. 21 Fig, 2 Tab, 52 Ref, 1 Append. NSF-INT 78-01159, NSF 77-26970.

Descriptors: *Tides, *Continental shelf, *Tidal effects, *Water circulation, *Model studies, Mathematical models, Sediments, Water levels, Circulation, Currents(Water), Tidal energy, Topography, Bathymetry, Stratification, Oceanography, *Cook Strait(NZ), *New Zealand, Tidal amplitudes, Tidal phases.

The application of an M sub 2 nonlinear numerical tidal model to the shelf seas of central New Zealand (approximately 38,500 sq km area) was described. It has provided a preliminary assessment of tidal and residual currents, bottom stress, energy dissipation, and the stratification index. The existence of a permanent, tidally driven mesoscale eddy (approximately 75 km diameter) was predicted north of D'Urville Island. Large spatial gradients in bottom stress qualitatively agreed with many features of the surficial sediment distribution. A comparison of all available bulk stratification data with the h/cu u stratification index clearly demonstrated the dominance of tidal vs. wind mixing over the control of summer stratification. A potential application of the model to fisheries science was suggested through a comparison of the stratification index contour map and some observations of squid fishing vessel locations. (Sims-ISWS)
W80-06123

RELATIONSHIPS BETWEEN HETEROTROPHIC BACTERIA AND POLLUTION IN AN INDUSTRIALIZED ESTUARY,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 5B.
W80-06126

EXPERIMENTS ON ARRESTED SALINE WEDGE,
North East London Polytechnic (England). Dept. of Civil Engineering.
J. P. Grubert.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15484, p 945-960, June 1980. 18 Fig, 18 Ref, 2 Append.

Descriptors: *Estuaries, *Diffusion, *Model studies, Diffusivity, Saline water-freshwater interfaces, Saline water intrusion, Hydraulics, Stratified flows, Waves(Water), Mixing, Froude number, Reynolds number, Saline wedge, Interfacial mixing layer.

Experimental results were presented that show that the onset of interfacial wave breaking can be expressed by a stability parameter that is a function of the interfacial densimetric Froude number and the interfacial Reynolds number. This parameter was shown to be independent of the flow Reynolds number upstream of a salt wedge and can be scaled to give a stability parameter for prototype flows. Measurements of the rate of mixing at the interface proved that mixing theory based on momentum exchange of turbulent flows is valid as a working hypothesis, and that this mixing is inversely proportional to the relative density. (Lee-ISWS)
W80-06128

A SAMPLER FOR COHESIVE SEDIMENT IN THE BENTHIC BOUNDARY LAYER,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 7B.
W80-06132

ANALYSIS OF ORGANIC CARBON IN MARINE SEDIMENTS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W80-06133

ROLE OF ADVECTIVE TERMS IN TIDALLY GENERATED RESIDUAL CIRCULATION,
Institute of Ocean Sciences, Sidney (British Columbia).
T. S. Murty, F. G. Barber, and J. D. Taylor.
Limnology and Oceanography, Vol 25, No 3, p 529-533, May 1980. 6 Fig, 20 Ref.

Descriptors: *Tidal waters, *Water circulation, *Inlets(Waterways), *Model studies, Path of pollutants, Tidal effects, Estuaries, Mathematical models, Flow characteristics, Coriolis force, Numerical analysis, Analytical techniques, Analysis, *British Columbia, *Masset Inlet.

Through the use of a numerical model, the role of the nonlinear advective terms in tidally generated residual circulation was explicitly demonstrated. This type of motion has been neglected in computations of dispersion and spreading of surface contaminants. The numerical model used was based on transports rather than currents and had been modified in various ways in a number of earlier applications (e.g., Murty and Taylor, 1975); here it was modified, after Greenberg (1977), to incorporate the advective terms. As Murty and Taylor (1975) noted, the numerical approach is quite simple and easily adaptable to any water body. (See also W76-10420 and W78-07116) (Humphreys-ISWS)
W80-06136

ON THE HYDROGRAPHY OF SHELF WATERS OFF THE CENTERAL TEXAS GULF COAST,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
N. P. Smith.
Journal of Physical Oceanography, Vol 10, No 5, p 806-183, May 1980. 7 Fig, 8 Ref. AA550-CT6-150-CT7-11.

Descriptors: *Hydrography, *Continental shelf, *Salinity, *Water temperature, *Texas, *Guld of Mexico, Sampling, On-site investigations, Surveys, Data processing, Variability, Spatial distribution, Temporal distributon, Seasonal, Temperature, Coasts, Oceanography, *Shelf waters, *Texas Gulf Coast.

Temperature and salinity data from 1976 and 1977 were used to describe low frequency hydrographic variations in Gulf of Mexico shelf waters off the central Texas coast. Data from 23 approximately monthly cruises define the annual cycle and suggest annually recurring seasonal events, Minimum salinitis occur in late spring, when values decrease to as low as 18 parts per thousand over the inner shelf. Inner shelf salinities during the rest of the year average 31-32 parts per thousand. Surface salinities over the outer shelf may decrease to 32-33 parts per thousand in late spring, but deviate little from 36 parts per thousand at other times. Both the mean salinity and the standard deviation suggest that freshwater runoff effects are restricted largely to inner and mid-shelf waters, within 30 km of the coast. Highest annual surface temperatures are 28-20 C across the shelf in late summer. Lowest temperatures in February range from 12-13 C over the inner shelf to 20-21 C over the outer shelf; minima appear to be highly dependent on the severity of the winter season in a given year. Bottom temperatures are dominated by the annual cycle over the inner shelf. Near-bottom temperatures over the outer shelf vary over shorter time intervals and cannot be resolved by monthly sampling. (Sims-ISWS)
W80-06183

DOWNWELLING OVER THE SOUTHERN CALIFORNIA SHELF,
Scripps Institution of Oceanography, La Jolla, Ca.
C. D. Winant.
Journal of Physical Oceanography, Vol 1-799, May 1980. 13 Fig, 15 Ref. NSF OCE78-19295.

Descriptors: *Water circulation, *Coasts, *Storms, *California, Continental shelf, On-site investigations, Currents(Water), Circulation, Temperature, Water temperature, Winds, Pressure, Atmospheric pressure, Oceanography, Meteorology, *Downwelling, Tropical storms.

Costal downwelling events, induced by tropical storms which travel up along the coast, occur regularly during the summer over the shelf of Southern California. Large vertical velocities (0.5 cm/s) were observed over the very narrow (3.6 km) shelf. Simultaneous observations of longshore current and cross pressure gradient indicated that the cross-shelf momentum balance is geostrophic. Heat balance computations revealed that the increase in mean temperature over the shelf is mostly caused by cross-shelf advection of heat. longshore accelerations occurring simultaneously at all depths in the shallower part o the shelf may be explained by longshore sea surface slopes contributing, along with the wind stress, to the longshore momentum balance. Profiles of temperature, along with the wind stress, to the longshore mementum balance. Profiles of temperature and velocity are consistent with a two-layer description of the vertical structure, these layers being separated by a thin, turbulent mixing layer. (Sims-ISWS)

W80-06184

ESTUARINE FRONT FORMATION AND PROPAGATION,
North East London Polytechnic (England). Dept. of Civil Engineering.
J. P. Grubert.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15485, p 961-975, June 1980. 11 Fig, 15 Ref, 2 Append.

Descriptors: *Saline water-freshwater interfaces, *Stratified flow, *Estuaries, *Model studies, Mathematical models, Hydraulic models, Flow, Saline water, Salinity, Density, Tides, Tidal waters, Coasts, Coastal engineering, Estuarine fronts.

Front conditions associated with estuarine saline wedges were investigated both theoretically and experimentally. It was deduced theoretically that two distinct front types should exist in a salt wedge estuary, namely wave fronts and St. Venant fronts. When the salt wedge is advancing in its ambient fluid on the flood tide, a wave front exists characterized by a vertical wall of water. On the ebb flow, however, when the salt wedge is retreating in its ambient fluid, a St. Venant front should occur characterized by zero depth at the front. Experiments confirmed that these two front types do occur, but due to stability constraints their frontal conditions are different from those predicted by theory. It was deduced that the fronts of all salt wedges effectively end at the critical flow section and that this should be the front criterion upon which a mathematical model of a salt wedge estuary is based. (Sims-ISWS)
W80-06194

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SOLAR POWERED ELECTRODIALYSIS - PART I: DESIGN OF A SOLAR POWERED ELECTRODIALYSIS SYSTEM FOR DESALTING REMOTE, BRACKISH WATER SOURCES.
Ionics, Inc., Watertown, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203805, Price codes: A08 in paper copy, A01 in microfiche. Report Prepared for Office of Water Research and Technology, Dec 1979, 161 p, 62 exhibits. OWRT C-80350-S(8576)(1). 14-34-0001-8576.

Descriptors: *Desalination, *Electrodialysis, *Solar power, *Brackish water, Membrane processes, Voltaic cells, Water supply remote locations, Desalting costs.

An evaluation was undertaken of alternative designs of a solar powered electrodialysis (SPED) system for a desalting application that is typical of the brackish water sources in the southwestern United States. The designs are evaluated relative to total water costs for an average water production of 4,000 gallons per day where the solar isolation averages 24 million joules per square meter per day (10 hours of collection) and the feed water contains 2,200 parts per million of dissolved solids. The optimal design, at current F.O.B. costs for a photovoltaic (PV) array of $10 per peak watt, minimizes the electrical storage requirements by matching the electrical duty of the desalting plant to the electrical output of the PV array. Including the requirements for well pumping (200 foot depth), the total water cost is $13.90/Kgal. At $5 per peak watt, the water cost drops to $12.00/Kgal. If well pumping is not required, the water cost can be further reduced to $9.60/Kgal. At $5 per peak watt, the water costs for the SPED plant and a generator powered plant are equal when the cost of fuel at location is $1.70 per gallon. Diagrams of the plant layout, process flow sheet and control circuit are included.
W80-06001

DESALTING HANDBOOK FOR PLANNERS.
Catalytic, Inc., Philadelphia, PA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202518, Price codes: A13 in paper copy, A01 in paper copy. Office of Water Research and Technology Report OWRT TT/80-3 Second Edition, September 1979, 321 p, 94 Fig, 21 Tab, 41 Ref. 14-34-0001-8701.

Descriptors: Desalination plants, *Desalination processes, Water supply, Water costs, Economics, *Planning, Evaluation, *Research and development, Distillation, Flash distillation, Electrodialysis, Reverse osmosis, Freezing, Ion exchange, Pretreatment(Water), *Estimated costs, *Design criteria, Construction, Waste water treatment.

This revised Handbook has extensive updating of text material and cost curves, primarily resulting from the most currently published literature from the Office of Water Research and Technology (OWRT). All chapters of this Handbook have been comprehensively revised to reflect latest technology and most recent costing information available to the desalting field. Major sources of data are referenced in the Handbook. Data together with background information and input from OWRT is compiled in a form suitable for water planner's use. The Handbook has been prepared for use in preliminary planning as a source of up-to-date information on the state of development, costs, economics, and applicability of those desalting processes which are available for providing water supply. It is anticipated that the Handbook will fill a particular need in conducting Western U. S. Water Plan Studies. The Handbook is not meant to substitute for the thorough engineering and economic analysis that should precede the decision to build a desalting plant.
W80-06013

PROCESS FOR RECOVERY OF CHEMICALS FROM SALINE WATER,
Ecodyne Corp., Lincolnshire, IL. (Assignee).
A. N. Chirico.
U.S. Patent No 4,180,547, 13 p, 4 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 989, No 4, p 1399, December 25, 1979.

Descriptors: *Patents, *Waste water treatment, *Saline water, *Desalination processes, Demineralization, Separation techniques, Desalination wastes, Potable water, Hardness(Water), Byproducts, Product recovery.

A continuous process is used to recover most of the sodium, magnesium, calcium, potassium, chlorine, bromine and sulfate present in saline water, particularly desalination plant by-product brine solutions. In addition, most of the water in the saline water feed may be recovered as potable water. In the process, a saline water feed is initially treated to remove essential all, 99% or more, of the magnesium and calcium in the form of salable compounds. Significant quantities of potable water are obtained during various steps of the process, primarily as vapor condensate during the crystallization steps. The principal advantages of the invention are the ability to exonomically recover as commercially salable compounds virtually all of the principal mineral and chemical constituents found in saline water and to simultaneously recover virtually of the water in the feed as potable water. These results are achieved as a result of the synergistic processing sequence of the invention. This processing sequence removes hardness at the beginning and permits clean, unscaled operating during the remaining steps. The processing sequence effectively precludes the formation of large quantities of the complexes and sludges which might tie up the valuable chemical constituents and significantly impair their recovery. (Sinha-OEIS)
W80-06176

REFRIGERATION TYPE WATER DESALINISATION UNITS,
Auscoteng Pty Ltd., Rose Park (Australia). (Assignee).
N. L. Foley.
U.S. Patent No 4,181,577, 6 p, 2 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 990, No 1, p 241, January 1, 1980.

Descriptors: *Patents, *Desalination, *Demineralization, *Separation techniques, Refrigeration, Evaporation, Condensation, Heat exchangers, Evaporators, Condensers.

In a water distillation system the heat supplied to the evaporator and the cooling of the condenser is provided by a refrigeration unit having its condensing coils in the evaporator and its evaporative coils in the condenser. To achieve the production of water which has its saline content removed, the invention comprises a feed control which maintains a regulated height of the feed water in an evaporator. This evaporator is connected to a condenser so that a flow of vapor can take place from the evaporator to the condenser. The condenser in turn has means to draw-off the liquified distillate for its intended use. (Sinha-OEIS)
W80-06178

3C. Use Of Water Of Impaired Quality

STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Harvana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W80-06022

3D. Conservation In Domestic and Municipal Use

THE RESPONSE OF ILLINOIS MUNICIPAL WATER SYSTEMS TO A PROLONGED PERIOD OF DROUGHT,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 2E.
W80-06079

3E. Conservation In Industry

RESEARCH ON NOVEL SOLVENT EXTRACTION SYSTEMS FOR INDUSTRIAL WATER REUSE.
Bend Research, Inc., OR.
For primary bibliographic entry see Field 5D.
W80-06032

INDUSTRIAL WATER REUSE WITH COUPLED TRANSPORT MEMBRANES.
Bend Research, Inc., OR.
For primary bibliographic entry see Field 5D.
W80-06033

3F. Conservation In Agriculture

NEW IRRIGATION SYSTEM DESIGN FOR MAXIMIZING IRRIGATION EFFICIENCY AND INCREASING RAINFALL UTILIZATION,
Texas A and M Univ., Lubbock. Agricultural Research and Extension Center.
W. M. Lyle, and J. P. Bordovsky.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202898, Price codes: A05 in paper copy, A01 in microfiche. Texas Water Resources Institute, Texas A and M University Project Technical Completion Report TR-105, May 1980, 68 p, 30 Fig, 11 Tab, 30 Ref. OWRT A-041-TEX(1). 14-34-0001-7092, 8046 and 9046.

Descriptors: *Irrigation systems, Design criteria, Water savings, Energy savings, Low energy-precision application system, Drop tubes, Orifice controlled emitters, Furrow irrigation, Sprinkler irrigation, Water conservation, *Texas high plains.

A new concept in irrigation system design, which has the potential of significant savings in both

water and energy requirements, has been developed and is under evaluation. The system is characterized by and has been labeled a low energy-precision application (LEPA) system, which rather than spraying water into the air at moderate to high pressures, distributes it directly to the furrow at very low pressure through drop tubes and orifice controlled emitters. This occurs as the system continuously moves through the field in a rectilinear fashion. The system is used in conjunction with micro-basin land preparation which also optimizes the utilization of rainfall. The combined system minimizes the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. Significant savings of both water and energy resources are indicated from results of the limited testing to date.
W80-06003

TENSIOMETER-CONTROLLED MEDIUM FREQUENCY TOPSOIL IRRIGATION: A TECHNIQUE TO IMPROVE AGRICULTURAL WATER MANAGEMENT,
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker.
Water SA (Pretoria), Vol 4, No 3, p 134-155, 1978. 18 Fig, 4 Tab, 16 Ref.

Descriptors: *Tensiometers, *Irrigation practices, *Soil management, *Distribution patterns, Soil chemical properties, Salinity, Moisture content, Water conservation, Soil moisture, Evaporation control, Seasonal, Leaching, Evapotranspiration, Irrigation effects, Sprinkler irrigation, Mist irrigation, Surface irrigation, Crop production, Crop response, Agriculture, *South Africa.

Tensiometer-controlled irrigation mangement was investigated to prevent over-irrigation and under-irrigation which induced soil salinization and to obtain the highest yield per unit water during short term water scarcity. The technique was tested in South Africa and citrus under drip irrigation at Zebediela, on wheat and soybeans under drip and microjet irrigation near Pretoria. Medium frequency irrigation was employed to keep the soil moisture in the tip of 0.045 m layer at a high water potential and the moisture in the subsoil at a low water potential. Irrigation water management was most critical during certain development stages in the plant growth such as germination and flowing. Moisture retention curves were drawn for three layers of four soils and tensiometer graphs depicting moisture withdrawal and replenishment were derived for each of the irrigation areas. Tensiometer data were shown to be quantitatively useful and accurate in irrigation management. Disadvantages may include variations in reading due to careless installation, critical placement of the tensiometer for accurate readings, and a time lag between irrigation and the correct tensiometer reading. (Sidney-IPA)
W80-06070

CENTER PIVOT CONSTRUCTION FOR CENTER PIVOT SPRINKLER,
Irrigation and Power Equipment, Inc., Greeley, CO. (Assignee).
R. E. Hunter, and R. C. Shook.
U.S. Patent No 4,180,092, 10 p, 9 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 989, No 4, p 1255, December 25, 1979.

Descriptors: *Patents, *Irrigation, *Irrigation systems, *Application equipment, Irrigation operation and maintenance, Irrigation efficiency.

An improved center pivot for a self-propelled center pivot irrigation system is disclosed. It is characterized by a vertical vipot pipe supported for rotational movement at both the upper and lower extremities. Additionally, the gasket assembly providing leak-proof rotational movement of the pivot pipe relative to a fixed supply pipe is characterized by a slideable casing which can be moved from a normal operating position, where the fixed supply pipe and the rotating pivot pipe are bridged by the casing with gaskets placed between mating surfaces, and a second non-bridged position where the gaskets are removable so as to allow replacement of worn gaskets without moving or removing any of the major pipe components of the sprinkler system. A strain relief assembly is carried by the casing and connectable to a conduit pipe extending the length of the pivot pipe to a packing gland through which the conduit pipe passes to connect to a collector ring assembly. (Sinha-OEIS)
W80-06173

WATER SPRINKLER,
R. E. DeWitt.
U.S. Patent No 4,180,210, 16 p 11 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 989, no 4, p 1295, December 25, 1979.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, Application equipment, Flow control, Irrigation efficiency, Irrigation operation and maintenance, Nozzles.

A water sprinklr is described for developing predetermined but variable patterns of water coverage. The sprinkler includes pattern-defining apertures which are contoured in accordance with desired patterns of wate coverage to pass varying but predetermined amounts of water as a sprinkler nozzle rotates. A sampling aperature progressively samples the outputs of selected pattern-defining apertures in synchronism with the rotation of the sprinkler nozzle so as to conform the water output of the nozzle to that of the desired pattern of water coverage. (Sinha-OEIS)
W80-06174

METHOD OF COVERING CORRUGATED DRAINAGE TUBES,
F. T. Beane.
U.S. Patent No 4,180,464, 4 p, 2 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 989, no 4, p 1375, December 25, 1979.

Descriptors: *Patents, *Irrigation, *Drainage systems, *Pipes, Protection, Irrigation operation and maintenance, Irrigation efficiency.

The drainage pipe industry has developed new types of flexible corrugated drainage and irrigation tubing where the wall includes alternating annular peaks and valleys and peripheral slotted openings arranged tranversely to the longitudinal axis of the tube. A sheet of flexible water-repellent material may be placed over the area of the tube in which the slotted openings are located. Alternatively a sheet of fine filtering material may be used instead of the water-repellent material. This invention provides an improved an improved sleeve which completely encircles in the flexible drainage pipe with a cylindrical or tubular length of relatively elastic, knit fabric material. The sleeve is of a diameter, in the relaxed condition, less than the diameter of the drainage tube. Due to the inherent elasticity of the knit fabric, the tubular sleeve provices a corrugated flexible drain pipe with a protective covering which is easily assembled on the pipe. Moreover, during transportation and movement of the pipe in the field, the sleeve will remain snugly in place, generally conforming to the configuration of the pipe, thereby preventing damage to the sleeve. (Sinha-OEIS)
W80-06175

SELF-PROPELLING WATERING APPARATUS,
Di Palma Irrigation S.A., Cavalle (France). (Assignee).
J-C. Moisan.
U.S. Patent No 4,181,257, 23 p, 15 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 990, No 1, p 136, January 1, 1980.

Descriptors: *Patents, *Irrigation, *Irrigation systems, Lateral conveyance structures, Irrigation operation and maintenance, Application equipment, Irrigation efficiency.

A mobile watering apparatus has a framework which is provided with wheels and supports a watering nozzle as well as a drum forming rotary magazine for a pipe, one end of which is connected to the nozzle. The other end of the pipe, leaving the drum, is adapted for connection to a water supply station on the land. A hydraulic motor, actuated by water under pressure, allows the traveling of the apparatus and the joint winding of the pipe on the drum, with however, a slip clutch in the second case. This slip clutch is preferably controlled by a means responsive to the tension being exerted on the pipe. (Sinha-OEIS)
W80-06177

DRAIN DEPTH AND SUBIRRIGATION IN LAYERED SOILS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
Y. K. Tang, and R. W. Skaggs.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15457, p 113-122, June 1980. 6 Fig, 1 Tab, 15 Ref, 1 Append.

Descriptors: *Subsurface irrigation, *Subsurface drainage, *Soil water movement, *Model studies, Mathematical models, Drains, Tile drains, Subsurface drains, Irrigation, Soils, Soil types, Hydraulic conductivity, Subsurface flow, Irrigation practices, Irrigation efficiency, Agriculture.

The Richards equation for two-dimensional saturated-unsaturated water movement was solved for subirrigation from buried drains in layered soils. Numerical solutions were obtained for soils that have subsurface layers with high hydraulic conductivities. Results showed that increasing the drain depth so that it approaches or penetrates a high conductivity bottom layer will reduce head loss due to convergence near the drain. Deeper drains significantly increased subirrigation rates for deep soils and narrow drain spacings but had a smaller effect for shallow profiles and wide spacings. The response to deeper drains also increased with hydraulic conductivity and thickness of the bottom layer. The results showed that the drain should be placed at the interface of the high conductivity layer when possible. Further increases in the depth of the drain did not result in significant increases in subirrigation rate or water table rise. (Sims-ISWS)
W80-06197

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

HYDROLOGY OF JUMPER CREEK CANAL BASIN, SUMPTER COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. Anderson.
Available from the OFSS Box 25425, Fed. Ctr. Denver Co 80225, paer copy $5.75, microfiche $3.50. Geological Survey open-file report 80-208 (WRI), 1980. 41 p, 11 Fig, 4 Tab, 6 Ref.

Descriptors: *Hydrology, *Canals, *Watersheds(Basins), *Florida, *Evaluation, Effects, Streamflow, Rainfall, Flood control, Surface runoff, Subsurface runoff, Evapotranspiration, Aquifers, Potentiometric level, Water levels, Surface waters, Groundwater, Water quality, Planning, Channels, Excavation, *Jumper Creek Canal basin(FL). *Sumter County(FL).

Jumper Creek Canal basin in Sumter County, Florida, was investigated to evaluate the overall hydrology and effects of proposed flood-control works on the hydrologic regiment of the canal. Average annual rainfall in the 83-square mile basin is about 53 inches of which about 10 inches runs off in the canal. Average annual evapotranspiration is estimated at about 37 inches. Pumping from limestone mines has lowered the potentiometeric surface in the upper part of the basin, but it has not significantly altered the basin yield. Channel excavation to reduce flooding is proposed with seven

control structures located to prevent overdrainage. The investigation indicates that implementation of the proposed plan will result in a rise in the potentiometric surface n the upper basin, a reduction is surface outflow, an increase in subsurface outflow, an increase in the gradient of the potentiometeric surface of the Floridan aquifer, an increase in leakage from the canal to the aquifer in the upper basin, and an increase in the magnitude of flood flows from the basin. Ground water in Jumper Creek basin is a bicarbonate type. Very high concentrations of dissolved iron were found in shallow wells and in some deep wells. Sulfate and strontium were relatively high in wells in the lower basin. (Kosco-USGS)
W80-06063

WATER FROM THE WATERSKLOOF,
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 8A.
W80-06073

COPING WITH THE ONE-IN-TEN-YEARS STORM,
The South African Sugar Journal. Vol 63, No 3 p 113, March 1979, 1 Fig.

Descriptors: *Channels, *Drainage systems, *Flood control, *Water control, *Grassed waterways, Soil erosion, Surface runoff, Crop production, Channel improvement, Excavation, Flood routing, Floodways, Open channels, Surface drainage, Land forming, *South Africa, *Watershed management.

The construction of large grassed waterways in the Western Transvaal maize belt of South Africa is helping to get rid of annual flood waters, keep soil on the farms, and increasing crop yields by up to 200% over previous years. The area, which supports vast fields of maize, is almost flat and apparently devoid of natural drainage systems. The natural waterways that did exist have been planted or built on. In the seasons of 1975, 1976, 1977, and 1978, flooding was extensive with some areas getting over 800 mm of rain, resulting in crop failure and severe erosion. To solve this problem, the farmers, the Provincial Administration, commercial and industrial firms, and the staff of the Department of Agricultural Technical Services, all cooperated to construct waterways. Aerial photographs and physical contour surveys were used to determine the locations for the waterways. In order to cope with the once-in-ten-year storm, some waterways will be up to 35 kilometers long and 100 meters wide, with an average depth of 300 mm. Soil that was excavated was dumped in the center creating two waterways, making the water easier and safer to handle. Divesions, culverts, and bridges were also constructed for roads and houses. Storm water drains will also be constructed to more rapidly direct the runoff into the waterways which will be grass covered. (Seigler-IPA)
W80-06074

A VARIANCE-CONSTRAINED RESERVOIR CONTROL PROBLEM,
IBM Thomas J. Watson Research Center, Yorktown Heights, NY.
For primary bibliographic entry see Field 2H.
W80-06145

4B. Groundwater Management

EVALUATION OF INDUCED INFILTRATION BETWEEN THE RIVER SKERNE AND THE MAGNESIAN LIMESTONE IN SOUTH EAST DURHAM,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
L. Hamill.
Journal of the Institute of Water Engineers and Scientists, Vol 34, No 2, p 161-171, March, 1980. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Induced infiltration, *Aquifers, *Rivers, Ground water mining, Withdrawal, Droughts, Conjunctive use, Pumping, Water levels, Ground water recharge, Water quality, Water pollution, Surface-ground water relationships, Leakage, Computer models, Water management(Applied).

This paper examines the problem of induced infiltration resulting from ground water overpumping during droughts. Depending on water quality, induced infiltration can be either advantageous by increasing the yield of the well, or potentially disastrous by causing ground water pollution. In either case, if an estimate of the rate of river leakage can be obtained, a model could be constructed to calculate the maximum withdrawal rate that could be tolerated without the associated river leakage exceeding either qualitative or quantitative limits. Such a model was used in a study of induced infiltration between the magnesian limestone aquifer of south east Durham and the River Skerne. Results of this study indicate that the pattern of recharge changed significantly when ground water levels declined below a critical value, the aquifer could be used for water supply during periods of high ground water levels, and the aquifer could be pumped to give a high yield but a low rate of river leakage. Thus it may be possible to develop an aquifer which had previously been thought unsuitable for water supply, manage existing aquifers more efficiently, and use ground and surface water resources conjunctively to obtain optimum yield during droughts without overexploiting either resource. (Purdin-NWWA)
W80-06020

STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Harvana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
S. P. Singh, and V. N. M. Vadali.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 106, No IR 2, p 93-104, June, 1980. 6 Fig, 4 Tab, 17 Ref, 1 Append.

Descriptors: *Aquifer management, *Saline water, *Freshwater, *Storage, Saline water-freshwater interfaces, Artificial recharge, Water spreading, Mixing, Diffusion, Skimming, Water wells, Finite difference analysis, Equations, Numerical analysis, Particle size, Water quality, Ground water.

One approach to managing landlocked saline aquifers is to recharge them with freshwater through injection wells or surface spreading. The latter method is more economical to operate. As the freshwater infiltrates from the surface it forms a layer over the saline water and can be pumped at a later stage through 'skimming wells'. However, some mixing of fresh and saline waters will occur due mainly to diffusion. It is assumed that the aquifer is uniform, isotropic and horizontal and there is no lateral movement of water. Experiments were conducted to determine the functional form of the diffusion coefficient. The diffusion coefficient was found to be dependent on concentration and aquifer material. An implicit finite difference solution of the nonlinear diffusion equation was developed. This numerical solution was used to determine the salinity profiles with respect to time in a freshwater layer stored over a saline layer. The salinity profiles are useful in predicting the water quality of the recharged freshwater layer. (Purdin-NWWA)
W80-06022

RADIAL PUMP SAVES ON WATER DRAWING,
For primary bibliographic entry see Field 8A.
W80-06046

MAPS SHOWING GROUND-WATER CONDITIONS IN THE HOPI AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA--1977,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06052

CLASSIFICATION OF GROUND-WATER RECHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
K. S. Muir, and M. J. Johnson.
Available from OFSS, Box 25425, Fed. Ctr. Denver, CO. 80225. Paper copy $3.50, microfiche $0.50. Geological Survey open-file report 79-1065 (WRO), December 1979. 1 Sheet, 2 Fig, 5 Ref.

Descriptors: *Groundwater recharge, *Evaluation, *California, *Groundwater potential, *Geology, Aquifer characteristics, Natural recharge, Permeability, Groundwater resources, Planning, Water quality, Water pollution control, *Santa Cruz County(CA).

Ground-water recharge potential was classified in the Santa Cruz coastal area, North-central area, and Soquel-Aptos area in Santa Cruz County, Calif., for three data elements that affect recharge; slope, soils, and geology. Separate numerical maps for each element were composited into a single numerical map using a classification system that ranked the numbers into areas of good, fair, and poor recharge potential. Most of the Santa Cruz coastal area and the Norht-central area have a poor recharge potential, and much of the Soquel-Aptos area has a good to fair recharge potential. (Kosco-USGS)
W80-06056

PLANNING GROUNDWATER SUPPLY SYSTEMS FOR URBAN GROWTH: APPLICATIONS TO WEST LAFAYETTE, INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
G. V. Loganathan, J. W. Delleur, and J. J. Talavage.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207491, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 131. July 1980. 74 p 13 Fig, 9 Tab, 36 Ref, 2 Append. OWRT B-083-IND(1).

Descriptors: *Well spacing, *Water distribution, *Water supply, Water wells, Groundwater, Drawdown, Aquifer management, Distribution patterns, Urban land use.

In Water supply systems predicting the spatial disaggregation of the demand is one of major concern. In this study a landuse allocation model is used for this purpose. The future zonewise development of different landuse activities is converted into an equivalent water demand based on the requirements of the activities projected. Other important facets are the determination of optimal locations of water wells and of distribution reservoirs along with the optimal flow values and pipe sizes. The annualized cost of the well field, distribution reservoirs, pipes and pumping is minimized. The indivisibility requirement of the number of wells and reservoirs and the continuous variation of flow values require the use of a Mixed Integer Programming (MIP) approach for the optimization. The nonlinear head losses result in nonlinear objective function and constraints. The nonlinearity is circumvented by making use of empirical formulas and well design criteria. The new are located so that the additional drawdowns do not adversely affect the existing system. A two level coordination scheme is used to optimally distribute the facilities and to guarantee a safe exploitation of the aquifer in the future. This task is performed by the program WATSUP, which includes a finite element formulaton of the groundwater flow. The methodology is applied to an actual dituation in West Lafayette, Indiana.
W80-06158

STORAGE OF FRESHWATER IN SALINE AQUIFERS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agricultural Engineering.
S. P. Singh, and V. V. N. Murty.
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 106, No IR2, Proceedings Paper 15476, p 93-104, June 1980. 6 Fig, 4 Tab, 17 Ref, 2 Append.

Descriptors: *Aquifers, *Saline water-freshwater interfaces, *Diffusion, *Model studies, Hydraulic models, Laboratory tests, Mathematical models, Mixing, Recharge, Artificial recharge, Groundwater recharge, Groundwater, Storage, Salinity, Salts, Freshwater, Water management(Applied), *Aquifer management, Saline aquifers, Freshwater storage.

Studies were conducted to determine the salinity profiles in a freshwater layer stored over saline water in groundwater aquifers. The one-dimensional diffusion equation was taken as the governing equation, and the diffusion coefficient was assumed to be dependent upon concentration. Using this experimental data, the authors determined the functional form of the diffusion coefficient. An implicit finite difference solution was used to solve the nonlinear diffusion equation. The solution has been used to determine the salinity profiles in the freshwater layer. (Sims-ISWS)
W80-06199

4C. Effects On Water Of Man's Non-Water Activities

DISSOLVED OXYGEN IN INTRAGRAVEL WATER OF THREE TRIBUTARIES TO REDWOOD CREEK, HUMBOLDT COUNTY, CALIFORNIA,
Geological Survey, Helena, MT. Water Resources Div.
P. F. Woods.
Water Resources Bulletin, Vol 16, No 1, p 105-111, February 1980. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Dissolved oxygen, *Water quality, *Sediment transport, *Particle size, *Tributaries, Streamflow, Watersheds(Basins), Lumbering, Surface waters, *Redwod Creek(CA), *Humboldt County(CA).

As part of a study of Redwood National Park in northwestern California an investigation was conducted from June to November 974 on intragravel dissolved oxygen and sediment in three tributaries to Redwood Creek, a major coastal stream that flows through Redwood National Park. Of concern was whether the intragravel environment of streams in logged redwood-forested drainage basins was different. The tributary in the unlogged drainage basin had lower percentages of fine streambed sediment than either of the tributaries in logged drainage basin. Concentration and percentage saturation of dissolved oxygen of intragravel water were highest in the stream in the unlogged drainage basin, intermediate in the stream in the patch-cut drainage basin, and lowest in the stream in the clear-cut drainage basin. The differences in intragravel dissolved-oxygen conditions among the three tributaries are attributed chiefly to differences in their interchange of surface and intragravel water. The large quantities of fine streambed sediment in the two strems in logged basins may have reduced the permeability of the streambeds and hence their capacity to interchange surface and intragravel water. However, differences in the lithology of the three tributary drainage basins examined may contribute to the differences in the percentage of fine sediments observed among the streams, even in the absence of logging. (Kosco-USGS)
W80-06066

URBANIZATION-INDUCED IMPACTS ON INFILTRATION CAPACITY AND ON RAINFALL-RUNOFF RELATION IN AN HAWAIIAN URBAN AREA,
Hawaii Univ., Honolulu. Water Resources Research Center.
E. T. Murabayashi, and Yu-Si Fok.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-206196, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 127, September 1979, 48 p, 13 Fig, 10 Tab. OWRT-A-050-HI(1), 14-31-0001-5011, 14-34-0001-6012, 7025, 7026.

Descriptors: *Infiltration, *Rainfall-runoff relationships, *Urbanization, *Storm runoff, Land use, Flood hydrology, Soil moisture, Hawaii, Green-Ampt equation, ILLUDAS model, Oxisol, St. Louis Heights watershed, Mililani Town, Oahu.

The effect of urbanization on infiltration and rainfall-runoff relations was investigated at Mililani town, Oahu, Hawaii, a residential community. The double-ring method determined the mean constant infiltration rate be 17.58 cm/hr (7.03 in./hr) under preurban, long-abandoned, and overgrown pineapple field conditions. Following the transitional grubbing and lot-shaping operations, the rate slowed respectively to 7.45 cm/hr (2.98 in./hr) and 1.28 cm/hr (0.51 in./hr). The rate rose slightly to 2.95 cm/hr (1.18 in./hr) under lawn, the new permanent cover. There was no significant difference between recreational and nonrecreational lawns. Incorporated in these results are unmeasurable quantities of lateral flow through the porous soil under original and grubbed conditons. Based on the data, however, the constant infiltration rate is reduced 83% after urbanization. For single-family residential areas the impermable area overlaid by paving and buildings was 57% of the total surface area; for town houses it was 64%. Based on the experimental data for single-family residential areas, the combined effect of reduced soil infiltration and accrued impermeable surface area is estimated to reduce infiltration opportunity 10 to 1 after urbanization. Or, there may be as much as 93% reduction in infiltration after urbanizatin, depending on whether rainfall frequency, intensity, and furation exceed infiltrative capacity. the impact of urbanizatin was evaluated with a digital using the St. Louis Heights Watershed Model (modified ILLUDAS) with field masured rainfall-runoff relations as the basis for verification. When pervious lawns surface is substitutted for impervious areas as inputs, the peak runoffs are much less than those simulated with existing impervious lands. The reduction in peak runoff from one selected storm is estimated at 79% of the observed peak.
W80-06078

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

TRANSFERENCE MECHANISM OF POLYCHLORINATED BIPHENYL BY AQUATIC ORGANISMS,
Georgia Univ., Athens. Coll. of Experiment Station.
M. K. Hamdy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202864, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology, Atlanta, Report No ERC 01-80, January 1980, 51 p, 8 Fig, 8 Tab, 21 Ref, 2 Append. OWRT A-073-GA. 14-34-0001-8011.

Descriptors: *Polychlorinated biphenyls, Uptake, Depuration, Water pollution, Biotransference, Food chain, Aquatic organisms, Sediments.

Thirteen polychlorinated biphenyls (PCBs) resistant cultures were isolated from sediments containing more than 1000 ug PCB/g sediment. These cultures were found to be of the genus Bacillus. The authors were able to induce some mutants from these cultures than can grow in laboratory basal salt medium containing high levels of PCB (2500 ug PCB/ml medium). These mutants were also able to biodegrade the PCBs (1254) compounds. The effectiveness of this biodegradation varied between mutants and ranged from 42-62%. It is concluded that feasibility studies, on an economical bases, should be looked at with emphasis on end product. Both uptake and concentration factor (CF) of 14C-Polychlorinated biphenyls were determined in several flood chain systems and were affected by the trophic level, incubation time and by age of cells. Bacterial cells containing 14C-PCB were fractionated into 5 fractions; cold TCA, alcohol, alcohol-ether, hot TCA, and proteins. Most of the radioactivities were in alcohol (60%) and alcohol-ether fractions (17%) indicating bioaccumulation in cellular lipids. Three day larvae exhibited a 5.14% uptake and 553 CF at 96 hr; 5 day larvae had 2.56% uptake and CF of 209. Guppies showed 3.56% uptake and CF of 197 at 96 hr. It is concluded that all food chain systems examined showed a high level of PCB uptake and concentration factor.
W80-06004

INVESTIGATION OF GROUNDWATER QUALITY AND ITS EFFECT ON SUBURBAN DEVELOPMENT IN WASHOE VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
A. T. Armstrong, and J. W. Forham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203326, Price codes: A04 in paper copy, A01 in microfiche. Project Report No 48, 1977. 60 p, 8 Fig, 5 Ref, 3 Append. OWRT A-065-NEV(2). 14-34-0001-6029.

Descriptors: *Groundwater quality, *Community development, Urbanization, Water analysis, Water quality, Chemical analysis, Streamflow, Water wells, Path of pollutants, Nevada, Truckee River System(NV).

In response to water quality problems in the New Washoe City-Washoe Farms portion of the Washoe Valley, Nevada, an area of more than 200 households, a water quality study was initiated in November 1974 by the Water Resources Center. During the course of the study, 257 water samples were collected for chemical analysis from domestic wells and streams flowing into the valley. In addition, approximately 260 well analyses were available from other sources. Also, the rates of flow were measured, on a monthly basis, of inflowing streams for a period of one year. The study has yielded knowledge not previously available. This information is however, subject to revision and refinement as more wells are sampled by other interested parties. The major points are: (1) Surface inflow may be eliminated as the direct source of contamination in the groundwater of the New Washoe City-Washoe Farms area. (2) A more accurate estimate of the volume of surface inflow to the valley than was previously possible has been made. (3) The areal occurrences of fluoride, nitrate and iron, which constitute the major water quality problems is described as well as numerous other constituents of interest and areas of deleterious levels delineated. (Schulke-Nev)
W80-06005

EVALUATION OF MUTAGENICITY TESTING OF EXTRACTS FROM PROCESSED OIL SHALE,
Utah Water Research Lab, Logan.
J. G. Dickson, and V. D. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-203458, Price codes: A04 in paper copy, A01 in microfiche. Report No UWRL/Q-80/01, Water Quality Series, May 1980. 49 p, 20 Fig, 13 Tab, 135 Ref. OWRT B-154-UTAH(1). 14-34-0001-8123.

Descriptors: *Oil shales, *Pollutant identification, *Toxicity, *Bioassay, Laboratory tests, Bioindicators, Testing procedures, Salmonella, Water pollution, Chemical analysis, Organic compounds, Water pollution effects, Cytological studies, Evaluation, Mutagenesis, Ames test.

The evaluation of the carcinogenic potential of processed oil shale extracts was carried out by the use of the Ames/Salmonella mutagenicity assay. Four types of spent oil shale were used to obtain samples for testing and the polycyclic aromatic hydrocarbons (PAH) contained in the shale extracts are known to give about 90% detection rate by the Ames test. Soxhlet extraction of the shale with organic solvents gave extracts which were found to contain mutagenically-active fractions. The choice of solvents was shown to have a great effect on the magnitude of the mutagenic response and may also generate a co-mutagenic effect. The Ames test failed to identify mutagens in the aque-

ous leachates from the spent oil shale. One of the major problems of the Ames test was that the dose response curves of one-to-one mixture of two mutagens were nonadditive. Benzo (a) pyrene, a strong mutagenic PAH, was found to mask the mutagenic response of other mutagens. The complex mixture of PAHs in processed oil shale may exhibit high mutagenicity due to possible co-mutagenesis. Further biological testing is necessary to establish the environmental impact of natural leaching of oil shale waste and the reliability of the Ames test. (Sidney-IPA)
W80-06009

ACUTE TOXICITY TO GOLDFISH OF MIXTURES OF CHLORAMINES, COPPER, AND LINEAR ALKYLATE SULFONATE,
Maryland Univ., Solomons. Chesapeake Biological Lab.
C. -F. Tsai, and J. A. McKee.
Transactions of the American Fisheries Society, Vol 109, p 132-141, 1980. 7 Fig, 3 Tab, 28 Ref. OWRT-A-029-MD(2), 14-34-0001-7044.

Descriptors: *Bioassay, *Toxicity, *Copper, *Linear alkylate sulfonates, Chemical properties, Detergents, Sewage effluents, Waste treatment, Chlorination, Ammonia, *Chloramines, *Goldfish, *Carassius.

The toxicity to goldfish (Carassius auratus) of mixtures of chloramines, copper, and linear alkylate sulfonate (LAS) was studied by continuous-flow toxicity tests during an exposure period of 96 hours. The individual toxicities of these three chemicals are either additive or synergistic in mixtures, depending on the rate of toxic action of the individual chemical, the toxicity ratio of the chemicals in the mixtures, and the concentration of the mixtures. (Deal-EIS)
W80-06042

OCCURRENCE OF SALT AND LEAD IN SNOW DUMP SITES,
Ontario Hydrology, Toronto. Dept. of Transmission Environment.
W. S. Scott.
Water, Air, and Soil Pollution, Vol 13, No 2, p 187-195, June 1980. 5 Fig, 4 Tab, 7 Ref.

Descriptors: *Snow, *Salts, *Lead, *Deicers, Roads, sodium, Chlorides, Pollutant identification, Water pollution, Melt water, Runoff, Soils, Soil contamination, Sampling, Chemical analysis, path of pollutants, *Toronto(Ontario), Snow dumps.

Sodium, Cl, and Pb contents of snow, meltwater, and soil from ten Metropolitan toronto snow dumps were determined. Contaminant concentrations were related to the source of the snow. Although initially very high, Na and Cl concentrations in the snow decreased with time while piled at the dump site. Conversely, Pb content increased with time as the snow gradually melted and the Pb-containing particulates accumulated on the snow surface. The Na and Cl content of the meltwater was related to the concentrations in the snow, but the mean levels decreased with time, indicating that parts of the piles with higher salt concentrations were melting and draining away before the remaining areas. Although some Na and Cl is leached from the soil during the summer months, much of the salt and most of the Pb remains to accumulate from year to year. Adjacent to the snow piles, the soil contained contaminant concentrations that were higher than control samples, possibly as a result of the movement of meltwater runoff. (Sims-ISWS)
W80-06085

DETERMINATION OF CERIUM IN MARINE SEDIMENTS,
Bhabha Atomic Research Centre, Bombay (India).
M. D. Borkar.
Water, Air, and Soil Pollution, Vol 13, No 2, p 133-141, June 1980. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Sediments, *Oceans, *Radioisotopes, Sampling, Chemical analysis, Colorimetry, Pollutants, Isotope studies, Pollutant identification, Monitoring, Coasts, Tidal water, *Cerium, *India, Marine sediments.

Marine sediments carry almost all the radioactive Ce that enters the ocean with the effluents released from the nuclear industry. The uptake of radioactive 144Ce by the sedentary organisms is influenced by the amount of stable Ce present in the sediment. A method was described for the determination of stable Ce in the sediments based onion exchange separatin and colorimetric measurement with Arsenazo I reagent. The effect of diverse cations on the recovery of Ce was discussed. Lanthanum, Y, Th, and Zr, which form colored complexes with Arsenazo I, did not interfere under the conditions of the experiment. The recovery of stable Ce ranged from 95-98%. Using the method, the stable Ce content in some sediments from coastal Bombay were observed to range from 20-99 ppm. The same method with minor changes was described for the determination of radioactive Ce in the sediments and illustrated with the analysis of a sediment sample. (Sims-ISWS)
W80-06086

ANALYSIS OF NON-POINT POLLUTION EXPORT FROM SMALL CATCHMENTS,
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W80-06090

POTENTIAL FOR CHANGING PHYTOPLANKTON GROWTH IN LAKE POWELL DUE TO OIL SHALE DEVELOPMENT,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 5B.
W80-06092

ORGANIC-RICH COLLOIDAL MARERIAL IN ESTUARIES AND ITS ALTERATION BY CHLORINATION,
Maryland Univ., College park. Dept. of Chemistry.
A. C. Sigleo, G. R. Helz, and W. H. Zoller.
Environmental Science and Technology, Vol 14, No 6, p 673-679, June 1980. 4 Fig, 5 Tab, 34 Ref.

Descriptors: *Colloids, *Estuaries, *Chlorination, *Trace elements, Halogens, Metals, Carbon dioxide, Water chemistry, Sampling, Chemical analysis, Pollutants, Water pollution, Organic matter, Data processing, Analytical techniques, Chemistry.

Major and trace element analyses for over 30 elements indicated that chlorination increases the concentration of halogens, Mn, and certain other trace elements in the colloidal organic material in esturarine waters. The primary halogen substituent in freshwater is chlorine, whereas in brackish waters the oxidation of Br(-) to HOBr by chlorine produces a dramatic bromine enrichment in chlorinated samples. In experiments designed to measure CO2 production, yields of about 1/3 mol of CO2 per mol of initial chlorine were found after storage of acidified, chlorinated smaples for 1 week. This suggests that oxidatin of organic matter, ultimarely to CO2, is quantitatively far more important than halogen substitution, or metal oxidation, in the consumption of chlorine.)Sims-ISWS)
W80-06093

THE DISTRIBUTION OF MERCURY, CESIUM-137, AND PLUTONIUM IN AN INTERMITTENT STREAM AT LOS ALAMOS,
Los Alamos Scientific Lab., NM. Environmental Science Group.
For primary bibliographic entry see Field 5B.
W80-06106

NUTRIENTS AND ASSOCIATED ION CONCENTRATIONS IN IRRIGATION RETURN FLOW FROM FLOODED RICE FIELDS,
Texas Agricultural Experiment Station, Beaumont.
For primary bibliographic entry see Field 5B.
W80-06108

NUTRIENT AND COLIFORM LOSSES INRUNOFF FROM FERTILIZED AND SEWAGE SLUDGE-TREATED SOIL,
Louisiana State Univ., Baton Rouge. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W80-06109

SORPTION OF DIBENZOTHIOPHENE BY SOILS AND SEDIMENTS,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W80-06110

ENVIRONMENTAL CONTAMINATION THROUGH RESIDUAL TRACE METAL DISPERSAL FROM A DERELICT LEAD-ZINC MINE,
Liverpool Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 5B.
W80-06111

OXIDATIVE POLYMERIZATION OF DISSOLVED PHENOLS BY SOLUBLE AND INSOLUBLE INORGANIC SPECIES,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
R. A. Larson, and J. M. Hufnal, Jr.
Limnology and Oceanography, Vol 25, No 3, p 505-512, May 1980. 2 Fig, 5 Tab, 35 Ref. NSF BMS-77-23389.

Descriptors: *Organic matter, *Streams, *Water chemistry, *Water properties, Oxidation, Polymers, Water quality, Water sampling, Sampling, Sediments, Analytical techniques, Analysis, Methodology, Laboratory tests, Hydrogen ion concentration, Phenols, Manganese, Iron, Zinc, Copper, Cations, Oxides, Metals, Dissolved organic matter, Polymerization, Catechol.

Transition metal oxides (MnO2, ZnO, CuO) and cations (Mn(2+), Fe(3+)) promoted the polymerization of dissolved catechol (1,2-dihydroxybenzene) and other catechol and pyrogallol derivatives. The manganese species were the most efficient. Colored polymers were formed from catechol much more rapidly in stream waters than in deionized water buffered to the same pH. Addition of sediments or clays increased polymerization; addition of EDTA or lowering the pH reduced it. Ultrafiltration or autoclaving of the stream water samples had no significant effect. The mechanism appears to incorporate an activation of dissolved O2 to a more reactive species, probably OH. (Humphreys-ISWS)
W80-06113

CHARACTERIZATION OF ORGANIC NITROGEN IN NATURAL WATERS: ITS MOLECULAR SIZE, PROTEIN CONTENT, AND INTERACTIONS WITH HEAVY METALS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W80-06114

DISTRIBUTION OF OXYGEN IN MARINE SEDIMENTS MEASURED WITH MICROELECTRODES,
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2L.
W80-06117

FRACTIONATION OF SEDIMENT OXYGEN DEMAND,
Illinois State Water Survey, Peoria.
W. Wang.
Water Research, Vol 14, No 6, p 603-612, 1980. 8 Fig, 3 Tab, 19 Ref.

Descriptors: *Sediments, *Lake sediments, *Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Phenols, Iron, Manganese, Sulfides, Oxygen, Lakes, Water pollution,

Pollutants, Sampling, Laboratory tests, Water pollution control, Toxins, Chemicals, Distillation.

Several biological inhibitors were tested for separation of biological and chemical sediment oxygen demand (SOD) of lake sediments. Phenol was selected. Chemical SOD was further separated by ferrous, sulfide, and manganous demand. The results showed that the major component of SOD is chemical in contrast to biological and that the demand due to iron predominates. (Sims-ISWS)
W80-06125

RELATIONSHIPS BETWEEN HETEROTROPHIC BACTERIA AND POLLUTION IN AN INDUSTRIALIZED ESTUARY,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 5B.
W80-06126

ANALYSIS OF ORGANIC CARBON IN MARINE SEDIMENTS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
P. N. Froelich.
Limnology and Oceanography, Vol 25, No 3, p 564-572, May 1980. 5 Fig, 6 Tab, 19 Ref. NSF DES-76-02318.

Descriptors: *Pollutant identification, *Organic matter, *Carbon, Laboratory tests, Methodology, Data collections, Analytical techniques, Analysis, Calcium carbonate, Water chemistry, Testing procedures, *Marine sediments, Organic carbon.

A method was presented for measuring organic carbon in both carbonate-rich and carbonate-poor marine sediments. Samples were sonicated with phosphoric acid to remove carbonates. The spent acid supernatant was analyzed for dissolved organic carbon, the solid residue for total carbon; their sum yields the organic carbon content of the sample. The technique is free from carbonate interferences, involves no losses due to acid solubilization, and has excellent precision (better than + or - 0.02% C sub org) and accuracy (better than + or - 2%). (Humphreys-ISWS)
W80-06133

THE EFFECTS OF TRANSECT DIRECTION ON OBSERVED SPATIAL PATTERNS OF CHLOROPHYLL IN LAKE TAHOE,
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W80-06135

TRACE METAL BUDGETS FOR A FORESTED WATERSHED IN THE NEW JERSEY PINE BARRENS,
Pennsylvania Univ., PA. Dept. of Geology.
K. A. Swanson, and A. H. Johnson.
Water Resources Research, Vol 16, No 2, p 373-376, April 1980. 5 Tab, 19 Ref.

Descriptors: *Trace elements, *Metals, *Forest watersheds, *Sampling, *New Jersey, Precipitation(Atmospheric), Streamflow, Groundwater, Lead, Copper, Nickel, Iron, Manganese, Cadmium, Pollutants, Water pollution, Pollutant identification, Path of pollutants, Trace metal budgets.

Deposition of Pb, Cu, Ni, Fe, Mn, and Cd on the McDonalds Branch Basin in bulk precipitation was 25.4, 5.3, 6.6, 64.6, 20.7, and less than 2 mg/sq m/yr for a 1 year period in 1978-1979. Output in streamflow was 1.7, 0.7, 1.9, 148, 12.8, and less than 1 mg/sq m/yr, respectively, and loss to deep groundwater was 1.4, 1.9, 2.3, 123, 20.4, and less than 1 mg/sq m/yr. Pb, Cu, and Ni accumulated in the basin, while there was a net loss of Fe and Mn from the ecosystem. The major mechanism for movement of Fe and Pb out of the basin was interpreted to be complexation with and transport by mobile organic matter. (Sims-ISWS)
W80-06144

THE INCIDENCE OF WATER QUALITY: A COUNTY LEVEL ANALYSIS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Economics.
P. Asch, and J. J. Seneca.
Water Resources Research, Vol 16, No 2, p 319-324, April 1980. 7 Tab, 14 Ref.

Descriptors: *Water quality, *Domestic water, *Income distribution, *Pollutants, Dissolved oxygen, Coliforms, Phenols, Arsenic compounds, Cadmium, Hardness(Water), Radiation, Correlation analysis, Potable water, Water supply, Barium.

Relationships between nine quality characteristics of domestic water systems and the income and racial composition of the using populations were examined for a national sample of counties. Simple correlations suggested a regressive distribution for some but not all pollutants. More detailed analysis of two pollutants adjusted for variation in size of county population and showed a regressive distribution of fecal coliform but an income neutral distribution of cadmium. The findings were far from definitive but point to the type of analysis required to draw broader incidence conclusions. (Sims-ISWS)
W80-06150

5B. Sources Of Pollution

INVESTIGATION OF GROUNDWATER QUALITY AND ITS EFFECT ON SUBURBAN DEVELOPMENT IN WASHOE VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 5A.
W80-06005

A MODEL TO ASSESS MIGRATION FROM SHALLOW LAND BURIAL FACILITIES,
Dames and Moore, Los Angeles, CA.
For primary bibliographic entry see Field 7C.
W80-06019

GROUND WATER POLLUTION BY SEPTIC TANK DRAIN FIELDS,
Washington Univ., Seattle. Dept. of Environmental Health.
For primary bibliographic entry see Field 5G.
W80-06023

MOVEMENT OF HEAVY METALS INTO A SHALLOW AQUIFER BY LEAKAGE FROM SEWAGE OXIDATION PONDS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
A. Wolfberg, Y. Kahanovich, M. Avron, and A. Nissenbaum.
Water Research, Vol 14, No 6, p 675-679, June, 1980. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Heavy metals, *Perched water, *Sewage lagoons, Sludge, Soil chemistry, Attenuation, Water pollution, Ground water, Nickel, Manganese, Copper, Cadmium, Chromium, Water reuse, *Israel.

Movement of Cu, Mn, Ni, Cr, and Cd from oxidation ponds to a shallow perched aquifer underlying the Dan Region Sewage Reclamation Project (Israel) is described. Movement depends on removal of metals into the sludge at the bottom of the ponds, rate of leakage, and the specific type and degree of interactions with the soils for each metal. The contribution of effluents to ground water was evaluated on the basis of chloride concentration. Ground water containing more than 60 percent effluents showed a hundred-fold decrease in Cu and Mn at a distance of 650 m from the ponds. Ni and Cd showed relatively little removal while Cr showed irregular distribution with distance. The concentrations of Cu and particularly of Mn in the ground water near the oxidation ponds was equal or greater than in the ponds themselves. This suggests that Cu and Mn are mobilized from the sludge into the intersticial waters, percolate into the ground water near the ponds and are then precipitated by increasing aeration during the movement of water away from the pond. Cd and Ni form stable soluble organic chelates which are only slightly removed by interaction with the sandy soil of the aquifer. (Purdin-NWWA)
W80-06026

WATER-QUALITY DATA FOR CANALS IN EASTERN BROWARD COUNTY, FLORIDA, 1975-78,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W80-06061

OCCURRENCE OF SALT AND LEAD IN SNOW DUMP SITES,
Ontario Hydrology, Toronto. Dept. of Transmission Environment.
For primary bibliographic entry see Field 5A.
W80-06085

ANALYSIS OF NON-POINT POLLUTION EXPORT FROM SMALL CATCHMENTS,
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
D. M. Griffin, Jr., T, J, Grizzard, C. W. Randall, D. R. Helsel, and J. P. Hartigan.
Journal of the Water Pollution Control Federation, Vol 52, No 4, p 780-790, April 1980. 17 Fig, 10 Tab, 13 Ref.

Descriptors: *Water pollution sources, *Urban runoff, *Storm runoff, Sampling, On-site investigations, Pollutants, Suspended solids, Biochemical oxygen demand, Nitrogen, Phosphorus, Coliforms, Precipitation(Atmospheric), Rainfal, Data processing, Analytical techniques, *Non-point water pollution sources.

Water pollution abatement programs in the U.S. have long been founded on a philosophy of point source control. This approach may have been a reflection of the repective comprehension levels of the impacts of point and nonpoint source pollution on receiving water quality. The pollutant loads contained in point source discharges are relatively simple to quantify because the point of entry into the watercourse is fixed, and the flow rates are generally known. Stormwater pollution loads, by contrast, generally have no fixed point of origin, and the flow rates are not as well documented. In recent years, more studies have been conducted at the level of detail necessary to adequately assess pollution generation by stormwater runoff. One factor affecting the magnitude of the runoff problem is certainly the land use within the runoff generating basin. Identifying those land use characteristis that most strongly affect the quality and quantity of runoff thus becoms essential inplanning the development of a watershed. Knowledge of physical-chemical properties of pollutant transport then becomes important in devising management strategies. An additional concern in trying to establish the land use characteristis of greatest importance is the nature of the data collected and, therefore, the appropriate method of analysis. The final objectives of the research reported in this paper were to establish the importance of some land use characteristics on nonpoint pollutant yields and to provide insight into mechanisms affecting the 'first flush' phenomenon frequently reported by researchers. A basic purpose of this paper, however, was to present a rational approach for the analysis of stormwater runoff data. (Sims-ISWS)
W80-06090

POTENTIAL FOR CHANGING PHYTOPLANKTON GROWTH IN LAKE POWELL DUE TO OIL SHALE DEVELOPMENT,
Utah Water Research Lab., Logan.
M. L. Cleave, D. B. Porcella, and V. D. Adams.
Environmental Science and Technology, Vol 14, No 6, p 683-690, Jun 1980. 6 Fig, 4 Tab, 29 Ref.

Descriptors: *Oil shales, *Phytoplankton, *Water pollution sources, *Laboratory tests, Leachate, Leaching, Lakes, Pollutants, Chemicals, Salts, Chemical analysis, Bioassay, Algae, Growth rates, Water pollution, Mining, *Lake Powell(UT).

The potential effects of oil shale leachate and salinity additions on the productivity of freshwater algae were studied in laboratory studies using batch bioassays. These batch bioassays were used to screen variations of water extractions of different processed and unprocessed oil shales, and the concentration effects of both the slats and the sale extractions on the growth of indigenous algae fromlake Powell. The batch bottle bioassays were conducted following the standard algal assay procedure as closely as possible. Variations in the standard algal assay procedure included mdia variation with the use of an indigenous algal genus isolated from Lake Powell. The growth of the indigenous algal genus (Scenedesmus) was stimulated by adding oil shale extract at lower concentrations. Higher concentrations of oil shale leachate inhibited the indigenous algal growth. (Sims-ISWS)
W80-06092

ORGANIC-RICH COLLOIDAL MARERIAL IN ESTUARIES AND ITS ALTERATION BY CHLORINATION,
Maryland Univ., College park. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W80-06093

EFFECTS OF CHEMICAL DEFOLIATION OF AN ABIES GRANDIS HABITAT ON AMOUNTS AND CHEMISTRY OF THROUGHFALL AND STEMFLOW,
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA.
For primary bibliographic entry see Field 2B.
W80-06105

THE DISTRIBUTION OF MERCURY, CESIUM-137, AND PLUTONIUM IN AN INTERMITTENT STREAM AT LOS ALAMOS,
Los Alamos Scientific Lab., NM. Environmental Science Group.
T. E. Hakonson, G. C. White, E. S. Gladney, and M. Dreicer.
Journal of Environmental Quality, Vol 9, No 2, p 289-292, April-June 1980. 2 Fig, 3 Tab, 10 Ref. DOE W-7405-ENG-36.

Descriptors: *Radioisotopes, *Pollutants, *Waste disposal, *Intermittent streams, Streams, Sediments, Effluents, Sampling, Monitoring, Distribution patterns, Spatial distribution, Path of pollutants, Water pollution, *Mercury, *Cesium, Variability, *Plutonium.

This paper summarized the results of a study on the distribution of Hg, 137Cs, 238Pu, and 239,240Pu in channel sediments and adjacent bank soils in an intermittent stream used for treated liquid effluent disposal since 1963. Concentrations of the three radionuclides and Hg in stream bank soils were comparable to adjacent channel sediments demonstrating that the stream bank serves as a deposition site for chemicals released to the channel. This finding has important implications on the long-term behavior of effluent contaminants since other studies at Los Alamos have shown that the vegetated stream banks retard downstream movement of chemicals bound to soils and provide a pathway for transport of these materials to biota. Concentrations of the radionuclides and mercury were more uniformly distributed with distance and depth in the channel sediments than in the bank soils. The action of priodic surface water in the channel partially explains those differences. Statistical analysis of the data revealed that 50-85% of the variability in contaminant concentrations in bank and channel locations was due to variation with distance, whereas depth contributed relatively little to variability. (Sims-ISWS)
W80-06106

NUTRIENTS AND ASSOCIATED ION CONCENTRATIONS IN IRRIGATION RETURN FLOW FROM FLOODED RICE FIELDS,
Texas Agricultural Experiment Station, Beaumont.
F. T. Turner, K. W. Brown, and L. E. Deuel.
Journal of Environmental Quality, Vol 9, No 2, p 256-260, April-June 1980. 2 Fig, 2 Tab, 13 Ref. EPA S802008.

Descriptors: *Water quality, *Rice, Runoff, *Irrigation, *Return flow, Flood irrigation, Nutrients, Ions, Nitrates, Nitrites, Ammonia, Hydrogen ion concentration, Feritlizers, Water pollution, Sampling, Monitoring, Data processing, Agriculture, Rice culture, Irrigation return flow.

A 3-year field study of nutrient and common ion concentrations in irrigation return flow (IRF) from flooded rice fields utilized replicated plots that received either recommended or excessive fertilizer rates with continuous flow or intermittent flood irrigation. All P and K and 40% of the (NH4)2SO4 nitrogen (N) were applied preplant and incorporated. The remaining N was applied just prior to permanently flooding (40%) and at 7-mm panicle stage (20%). The irrigation and plot waters were analyzed for NH4(+)-N, NO3(-)-N, NO2(-)-N, PO4(3-)-P, K(+), Ca(2+), Mg(2+), Na(+), Cl(-), and SO4(2-). Highest nitrate-N concentrations occurred early in the season before the permanent flood period but did not exceed drinking water standards. Nitrite-N concentrations in the IRF were low at all times. Maximum NH4(+)-N concentrations occurred following N fertilizer applications which were not incorporated into the soil and persisted in the floodwater for 5 to 7 days. These peak NH4(+)-N concentrations exceeded acceptable drinking water standards concentration by a factor of 10 or greater. Concentrations of PO4(3-)-P and K(+) in the floodwater were similar to those in the surface water used for irrigation. The concentration of the other common ions in the floodwater did not greatly exceed those in the irrigation water, and all were within concentrations acceptable for drinking water. Method of fertilizer application had more influence on IRF nutrient concentrations than did fertilizer rates or irrigation management practices. Under the conditions of this study, it appears that only the ammonium concentrations may have a detrimental impact on the quality of IRF from flooded rice fields. This potential problem could be minimized by preventing IRF for a period of 1 week following surface applications of (NH4)2SO4 fertilizer. (Sims-ISWS)
W80-06108

NUTRIENT AND COLIFORM LOSSES INRUNOFF FROM FERTILIZED AND SEWAGE SLUDGE-TREATED SOIL,
Louisiana State Univ., Baton Rouge. Dept. of Agronomy.
E. P. Dunigan, and R. P. Dick.
Journal of Environmental Quality, Vol 9, No 2, p 243-250, April-June 1980. 5 Fig, 4 Tab, 30 Ref.

Descriptors: *Runoff, *Fertilizers, *Sewage sludge, Nutrients, Nitrogen, Nitrogen compounds, Phosphorus, Potassium, Precipitation(Atmospheric), Rainfall, Bacteria, Coliforms, Sampling, Monitoring, Chemicals, Chemical analysis, Pollutants, Path of pollutants, Water pollution, *Nutrient losses.

Surface runoff losses of fertilizer elements from forage plots on Loring silt loam soil (5% slope) were monitored from three separate studies during an 11-month period. Incorporating approximately equal amounts of N and P from commercial fertilizer (150-66, kg N-P/ha) and sewage sludge (177-54, kg N-P/ha) did not significantly affect differences in N and P losses. Surface application of sewage sludge resulted in higher N and P losses than those from incorporated sewage sludge. The surface-applied sludge plots in the second experiment (14.8 metric tons/ha) had the highest N and P runoff losses of 3.24 and 0.39 kg/ha, respectively. These losses were due to a heavy rain that fell early in the test period. Increasing the rates of surface-applied sewage sludge from 16.2 to 28.9 metric tons/ha did not increase runoff losses of N but did increase P losses by 285. The N and P losses for all treatments were less than 1% of that added. The highest K losses (1.24 kg K/ha) came from the fertilized plots. In all sewage-treated plots, K losses were approximately equal to or lower than the control values. Precipitation was found to contain substantial quantities of NH4-N and NO3-N with respect to losses of these ions in the surface water. Work with 15NH4-N indicated that the 15NH4-N in the rain could contribute substantially to the total amount of N lost in the surface runoff water. There was also exchange of rain-NH4 and soil-NH4. Fecal coliform indicator bacteria (FC) counts in surface runoff waters from sewage-treated plots were very high in the first 11 to 17 days of the second and third experiments; counts of FC were as high as 55,000/ml. However, number decreased rapidly as the soil became drier. (Sims-ISWS)
W80-06109

SORPTION OF DIBENZOTHIOPHENE BY SOILS AND SEDIMENTS,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
J. J. Hassett, J. C. Means, W. L. Banwart, S. G. Wood, and S. Ali.
Journal of Environmental Quality, Vol 9, No 2, p 184-186, April-June 1980. 1 Fig, 2 Tab, 21 Ref. EPA 68-03-2555.

Descriptors: *Sorption, *Aromatic compounds, *Soils, *Sediments, *Model studies, Mathematical models, Organic compounds, Pollutants, Water pollution, Path of pollutants, Coal mine wastes, Sampling, Chemical analysis, Water pollution sources, Polynuclear, Heterocyclic, Hydrophobic sorption, Octanol-water partition coefficient.

The effect of sediment and soil properties on adsorption of dibenzothiophene, a potential carcinogenic and/or mutagenic compound, was examined. Sorption isotherms were determined on soil and sediments collected from the Ohio, Missouri, Mississippi, and Illinois rivers and their watersheds. The sorption isotherms were approximately linear over the entire concentration range studied. The linear adsorption or partition coefficient was significantly correlated with the organic carbon contents of the soils and sediments. The other factors tested (e.g., total clay, clay mineralogy, CEC, surface area, pH) were nonsignificant. The Koc value estimated from the octanol-water partition coefficient (Kow) was in good agreement with the Koc value of 11,230 determined experimentally. The sorption of dibenzothiophene as a result of a week solute-solvent interaction rather than a strong sorbate-sorbent interaction was discussed. (Sims-ISWS)
W80-06110

ENVIRONMENTAL CONTAMINATION THROUGH RESIDUAL TRACE METAL DISPERSAL FROM A DERELICT LEAD-ZINC MINE,
Liverpool Univ. (England). Dept. of Botany.
M. S. Johnson, and J. W. Eaton.
Journal of Environmental Quality,Vol 9, No 2, p 175-179, April-June 1980. 5 Tab, 18 Ref.

Descriptors: *Mine drainage, *Mine wastes, *Heavy metals, *Water pollution sources, Sampling, Laboratory tests, Chemical analysis, Lead, Zinc, Cadmium, Erosion, Sheet erosion, Gully erosion, Suspended solids, Pyrite, Metals, Water pollution, Water pollution effects, Agriculture, *Wales, Lead-zinc mines.

Studies of historical and current environmental problems in the vicinity of a derelict Pb-Zn mine at Parc, near Llanwrst in North Wales, have shown that heavy metal dispersal occurs through contaminated mine drainage waters and episodal erosion of an unstable tailings dam. Since the discontinuation of mining operations, an estimated 13,000 metric tons of metalliferous spoil, equivalent to 43 metric tons Pb, 104 metric tons Zn, and 1 metric ton Cd, have been eroded from the main tailings dam. Dispersal by a tributary of the River Conwy and redeposition during flooding events has caused extensive contamination of lowland agricultural pastures. Streamwater pollution by tailings and dissolved metal salts in mine effluent continues to have a pronounced adverse effect on the flora and fauna of the tributary. Under normal discharge conditions mean net transfer of metals into the main Conwy River approximates to 0.27 kg Pb, 15 kg Zn, and 0.1 kg Cd over 24 hours. However, because of the increases particulate load during

surface drainage and flooding episodes, net dispersal increases unequally for the different metals, to a rate above that anticipated from discharge-concentration relationships. With a remaining deposit of 250,000 metric tons of mine tailings, tip stabilization measures have been initiated as a safeguard against further degradation of natural resources in the locality. (Sims-ISWS)
W80-06111

THE ANNUAL CYCLE OF PLANKTON DIATOM GROWTH AND SILICA PRODUCTION IN THE INNER OSLOFJORD,
Oslo Univ. (Norway). Dept. of Marine Biology and Limnology.
For primary bibliographic entry see Field 2L.
W80-06115

STRATIFICATION OF AEROBIC METHANE-OXIDIZING ORGANISMS IN LAKE MENDOTA, MADISON, WISCONSIN,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 2H.
W80-06116

FRACTIONATION OF SEDIMENT OXYGEN DEMAND,
Illinois State Water Survey, Peoria.
For primary bibliographic entry see Field 5A.
W80-06125

RELATIONSHIPS BETWEEN HETEROTROPHIC BACTERIA AND POLLUTION IN AN INDUSTRIALIZED ESTUARY,
Hull Univ. (England). Dept. of Plant Biology.
R. Goulder, A. S. Blanchard, P. L. Sanderson, and B. Wright.
Water Research, Vol 14, No 6, p 591-601, 1980. 1 Fig, 8 Tab, 34 Ref.

Descriptors: *Water pollution, *Bacteria, *Estuaries, Heavy metals, Sewage, Metals, Copper, Lead, Zinc, Suspended solids, Organic matter, Toxins, Sampling, Data processing, Correlation analysis, Pollutants, Path of pollutants, *Humber estuary(England), *England.

Numbers and activities of heterotrophic bacteria and environmental variables related to pollution were measured in water samples from the Humber estuary. In general, bacterial numbers and activities were positively correlated with organic pollution, and there was no evidence of widespread inhibition of self-purification by toxic pollution. At one site, however, which was adjacent to a discharge of metal refinery effluent, correlations between bacteria and indicators of organic pollution tended to disappear, high levels of Cu, Pb, and Zn were recorded, and bacterial activities were negatively correlated with heavy metals. These observations suggest that toxic pollution caused local inhibition of bacteria. (Sims-ISWS)
W80-06126

FLUORESCENCE: ABSORBANCE RATIOS--A MOLECULAR-WEIGHT TRACER OF DISSOLVED ORGANIC MATTER,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
A. J. Stewart, and R. G. Wetzel.
Limnology and Oceanography, Vol 25, No 3, p 559-564, May 1980. 5 Fig, 1 Tab, 21 Ref. DOE EY-76-S-02-1599, COO-1599-150, NSF BMS-75-20322.

Descriptors: *Pollutant identification, *Organic matter, *Fluorescence, *Analytical techniques, Laboratory tests, Lakes, Methodology, Analysis, Chromatography, Measurement, Hydrogen ion concentration, Leachate, Testing procedures, Chemical analysis, Water chemistry, *Lawrence Lake(MI), Dissolved organic matter, Absorbance ratios.

Naturally occurring dissolved humic materials were fractionated according to molecular weight by dialysis and gel permeation chromatography. Components of higher molecular weight (greater than 3500) absorbed strongly at 250 nm but fluoresced weakly, whereas humic fractions of lower molecular weight fluoresced intensely per unit absorbance. With appropriate precautions, fluorescence:absorbance ratios may be useful in delineating seasonal and depth distribution patterns of dissolved humic materials of low and high molecular weight. (Humphreys-ISWS)
W80-06134

ROLE OF ADVECTIVE TERMS IN TIDALLY GENERATED RESIDUAL CIRCULATION,
Institute of Ocean Sciences, Sidney (British Columbia).
For primary bibliographic entry see Field 2L.
W80-06136

THE TRANSPORT OF A RADIOACTIVE SALT THROUGH A SEMI-INFINITE COLUMN OF POROUS MEDIUM: A PHYSICAL MODEL,
California Univ. Livermore. Lawrence Livermore Lab.
J. N. Lucas.
Water Resources Research, Vol 16, No 2, p 387-390, April 1980. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Soil water movement, *Porous media, *Tracers, *Salts, Laboratory tests, Model studies, Mathematical models, Radioisotopes, Sodium, Aqueous solutions, Solutes, Sodium chloride, Soil water, Groundwater, Path of pollutants, Soil science, Breakthrough curves.

A model study of the transport of radioactive tracer through a porous medium was carried out in columns of sand into which a radioactive salt solution, sodium-24 chloride, was introduced continuously. Mathematical equations were developed to describe the effluent concentration, for a semi-infinite column, during the transient phase for variable as well as for the constant input concentration. Furthermore, inspection of the relevant equation for effluent concentrations from long columns indicated that dispersion should be negligible in the steady state. The experimental data of effluent concentrations gave accurate agreement with the theoretical breakthrough curves predicted by the mathematical equations and with the steady state concentration value. (Sims-ISWS)
W80-06141

TRACE METAL BUDGETS FOR A FORESTED WATERSHED IN THE NEW JERSEY PINE BARRENS,
Pennsylvania Univ., PA. Dept. of Geology.
For primary bibliographic entry see Field 5A.
W80-06144

THERMOHALINE INSTABILITY IN ANISOTROPIC POROUS MEDIA,
Oslo Univ. (Norway). Dept. of Mathematics.
For primary bibliographic entry see Field 2F.
W80-06151

5C. Effects Of Pollution

A LAYMAN'S GUIDE TO IRON BACTERIA PROBLEMS IN WELLS,
National Water Well Association, Worthington, OH.
S. Smith.
Water Well Journal, Vol 34, No 6, p 40-42, June, 1980. 5 Fig.

Descriptors: *Iron bacteria, *Water wells, Corrosion, Water pollution, Ground water, Disinfection, Chlorination, Sulfur bacteria, Ammonium compounds, Surfactants, Slime.

Iron bacteria cause corrosion, impart an unpleasant taste and odor to well water, reduce well capacity and service life, and eventually necessitate redevelopment. They occur in two major forms: Gallionella and the Actinomycete group. Iron bacteria contribute to corrosion by using up the protective iron hydroxide coating on steel pipe, by providing a haven for sulfate reducing bacteria which produce corrosive by-products, and by enclosing and preserving galvanic corrosion sites. Most iron bacteria prefer a pH of 6 to 10, dissolved iron concentration from 0.01 to 4.0 ppm, 0.5 to 4.0 ppm dissolved oxygen, and a temperature range from 40 degrees to 60 degrees F. Iron bacterial contamination can be prevented by disinfecting anything that goes into the well. Chlorine is used due to its availability, low cost, ease of handling, and proven effectiveness. Chlorine in the form of calcium hypochlorite will flocculate bentonite, making it difficult to remove from the formation during development. Quaternary ammonium compounds kill bacteria more effectively than hypochlorites. In addition, they are excellent wetting agents capable of penetration into encrustation and out into the aquifer. Another effective disinfection method is to heat the water to 118 degrees F for ten minutes. (Purdin-NWWA)
W80-06016

THE PHOSPHORUS-CHLOROPHYLL RELATIONSHIP IN ROODEPLAAT DAM
Pretoria Univ., (South Africa). Dept. of Botany.
A. J. H. Fieterse, and D. F. Toerien.
Water SA (Pretoria), Vol 4, No 3, p 105-112, 1978. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Eutrophication, *Dams, *Phosphates, *Phosphorous, *Chlorophyll, *Algae, Tropic level, Limiting factors, Water quality, Nutrient requirements, Waste assimilative capacity, Water pollution sources, Impoundments, Standing waters, Distribution patterns, Mathematical models, Regression analysis, Water analysis, Variability, *South Africa.

The relationship between phosphate phosphorous (PO4-P) and chlorophyll a was investigated to establish a model for the eutrophication of the Roodeplaat Dam. Many of the impoundments in South Africa have excessive algae and/or macrophyte growths, which result in poor water quality. Surface samples were taken at various points in the dam and analyzed for inorganic nitrogen and phosphorous ions. Regression analysis of the averaged data indicated that algal growth was limited by the PO4-P concentration rather than by inorganic nitrogen. A reduction in the PO4 P concentration would then reduce algal growth and PO4 P concentration data is more applicable to South Africa conditions than Total P values. The significat relationship between chlorophyll a and PO4 concentrations upholds this conclusion. A model for eutrophication was developed for the Roodeplant Dam which may be applicable to similar bodies of water. Algal nuisance conditions can be expected to occur above a phosphate phosphorous concentration of 26 micrograms per liter. The eastern sections of the dam represented the upper threshold conditions for algal growth and phosphorous loading, probably because of loading via the Pienaars River. The trophic status and the intensity of eutrophication was accurately represented by the PO4-P parameter. (Sidney-IPA)
W80-06037

GENETIC AND PHYSIOLOGICAL ADAPTATION OF THE COPEPOD EURYTEMORA AFFINIS TO SEASONAL TEMPERATURES,
Maryland Univ., Baltimore County, Catonsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W80-06038

DELAYED BEHAVIORAL RESPONSES OF THE BALACKNOSE DACE (RHINICHTHYS ATRATULUS) TO CHLORAMINES AND FREE CHLORINE,
Marland Univ., College Station. Center for Environmental and Estuarine Studies.
J. A. Fava, Jr, and Chu-fa Tsai.
Comparative Biochemistry and Physiology, Vol 60C, p 123-128, 1978, 3 Fig, 4 Tab, 18 Ref. OWRT B-006-MD(10),14-01-0001-1910.

Descriptors: *Chlorine, Effects, *Fish, *Toxicity, *Fish behavoir, *Blacknose dace, Chloramines, Free chlorine, Time avoidance index, Entry avoidance index.

Delayed behavioral responses of the blacknose dace to chloramines and free chlorine were studied for periods up to 220 min to demonstrate the importance of time as a factor in estimating the behavioral response. Concentrations used were 0.07 and 0.17 mg/1 as total chlorine for chloramines and 0.07, 0.21 and 0.47 mg/1 for free chlorine. Fish avoided both chemicals at all concentrations studied. The latent period and median avoidance time of the fish to both chemicals decreased as the total chlorine concentration increased, and were shorter for chloramines than for free chlorine. The median avoidance time was shorter than the median lethal exposure time and much shorter than the median survival time. The results indicate the need to reference statements concerning the avoidance abilities of fish to the particular time required for such a response. Also, these fish have the capability to avoid chloramines and free chlorine in water before receiving a lethal dose, given the opportunity to readily find clean water.
W80-06039

THE MEASUREMENT OF TEMPERATURE TOLERANCE: VERIFICATION OF AN INDEX,
Maryland Univ., Baltimore County, Baltimore. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2L.
W80-06041

ACUTE TOXICITY TO GOLDFISH OF MIXTURES OF CHLORAMINES, COPPER, AND LINEAR ALKYLATE SULFONATE,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5A.
W80-06042

IRRIGATION RETURN WATER IMPACT ON SELECTED ATTACHED DIATOMS IN THE SACRAMENTO RIVER, CALIFORNIA,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
S. A. Ford, A. W. Knight, and D. E. Bayer.
vailable from the National Technical Information Service, Springfield, VA 22161 as PB80-205586, Price codes: A05 in paper copy, A01 in microfiche. Water Science and Engineering Papers 4511, July 1980. 82 p, 6 Fig, 12 Tab, 1 Append. (California Water Resources Center UCAL-WRC-W-447).

Descriptors: *Irrigation water, *Return flow, *Biological communitis, *Diatoms, *Agricultural runoff, Irrigation, Groundwater, Surface waters, Environmental effects, Ecology, Water pollution effects, California, *SacramentoRiver(CA).

While a large percentage of applied irrigation water is consumed through evapotranspiration, enough returns to a ground and surface waters to make irrigated agriculture the largest contributor of waste water in the state. Unfortunately, little is known of the impact these irrigation drainage waters have on the biological communities receiving waters. The purpose of this study is to determine the effect of a large irrigation drain on the composition and density of the attached diatom community in the Sacramento River, California. Its objectives are to identify the dominant attached diatom species in the Sacramento river and the Colusa Basin Drain at Knights Landing during the irrigation season, to characterize the impacts of irrigation return water on the productivity and composition of the river's attached diatom community, and determine the physiochemical properties of the returns which are responsible for these impacts. (Snyder-Cal)
W80-06080

SIZE-SELECTIVE PREDATION, LIGHT TRANSMISSION, AND OXYGEN STRATIFICATION: EVIDENCE FROM THE RECENT SEDIMENTS OF MANIPULATED LAKES,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2H.
W80-06118

THE EFFECT OF MOISTURE ON PHOSPHORUS DIFFUSION IN COAL MINE SPOILS,
North Dakota Univ., Grand Forks. Dept. of Physics.
J. W. Harrell, Jr, and M. Saeed.
Soil Science, Vol 129, No 5, p 161-265, May 1980. 4 Fig, 2 Tab, 12 Ref. USDI G0264001.

Descriptors: *Phosphorus, *Diffusion, *Spoil banks, *Coal mines, Strip mines, Soil moisture, Moisture content, Soil, Soil types, Soil properties, Nutrients, Laboratory tests, Data processing, Regression analysis, Soil science, Strip mine reclamation.

Phosphorus diffusion coefficients (D) have been measured as a function of water tension (psi) and water content (theta) in topsoil and spoil samples from two coal mine sites in western North Dakota. For all four soils, the observed dependence of D upon psi and theta can be well decribed by equations of the form D = Ae to the (-a psi)power + B and D =K(theta -E) to the p power + B. The results showed that D is almost 0 for water contents below that held at 15 bars, and it increases rapidly as the water in excess of that held at 15 bars increases. For most of the measurements, D in the spoil materials, was greater than in the topsoils for a given moisture tension. (Sims-ISWS)
W80-06186

ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,
Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
D. Mathur, T. W. Robbins, and E. J. Purdy, Jr.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 937 944, June 1980. 4 fig, 5 tab, 15 ref.

Descriptors: *Thermal pollution, *Water pollution effects, *Zooplankton, *Pennsylvania, Heated water, Powerplants, Cooling water, Sampling, Data processing, Statistics, Statistical methods, Regression analysis, Temperature, Water temperature, River flow, Plankton, Effects, Ponds, Powerplant impact, Conowingo Pond(PA).

Assessment of the impact of power station operation on zooplankton communities requires separation of natural variations from those due to the facility. Analysis of covariance (density of zooplankton at control station, ambient water temperature, and average daily river flow as covariats) proved powerful in separating the natural variations from those due to the operation of Peach Bottom Atomic Power Station (once-through cooling system) in Conowingo Pond, a 35.8-sq km impoundment on the lower Susquehanna River. The covariance technique overcame some of the problems associated with using ratio of density at control station to the density at an affected station to adjust for ambient variations. Significant differences in adjusted preoperational and postoperational means occurred but were not attributable to station operation. Multiple regression analysis indicated that an increase in zooplankton production, particularly in winter, would result with addition of heated water when river flows are less than 280 cu m/s. The zooplankters were subjected to an average Delta T of 10.0 C in winter and up to 8.0 C in summer. Zooplankton population showed a great amount of resiliency in Conowingo Pond. (Sims-ISWS)
W80-06190

5D. Waste Treatment Processes

REMOVAL OF COLOR FROM PAPER MILL WASTE WATERS,
Nalco Chemical Co., Oak Brook, IL. (Assignee).
J. J. Svarz.
U.S. Patent No 4,179,329, 3 p, 6 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 990, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Pulp wastes, Color, Separation techniques, Chemical precipitation.

Color can be removed from paper mill waste waters by adding to the waste water, preferably at a pH within the range of about 2 to about 7, a relatively small amount of a polyethylene imine having a molecular weight of at least 300. The amount used is sufficient to form a complex solid of the imine with the color bodies which can then be separated by settling or filtration. The amount of the imine can be as low as 10 ppm with respect to the waste water or bleachery effluent and, in most cases, will not exceed 2,000 ppm, depending upon the particular imine employed. (Sinha-OEIS)
W80-06017

MOVEMENT OF HEAVY METALS INTO A SHALLOW AQUIFER BY LEAKAGE FROM SEWAGE OXIDATION PONDS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 5B.
W80-06026

SYSTEM FOR ELECTROCATALYTIC TREATMENT OF WASTE WATER STREAMS,
Omnipure, Inc., Houston, TX. (Assignee).
W. A. Krause, and E. P. Shea.
U.S. patent No 4,179,347, 7 p, 3 fig, 18 ref; Official Gazette of the United States patent Office, Vol 989, No 3, p 994-995, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, Water pollution treatment, Separation techniques, Electrolysis, Foaming, Foam separation, Skimming, Filtration, Organic wastes.

A continuous system for disinfecting waste water streams, such as sewage and streams contaning organic matter and removing suspended solids is disclosed. A waste water stream is passed into an electrolytic cell open to the atmosphere and between a series of electrically charged parallel electrode plates. A controlled amount of electrolyte such as sodium chloride is added to the stream before it passes through the electrolytic cell. During passage between the electrode plates, a foam is generated which entrains suspended selected nutrient solids. The foam is removed by skimming and/or suction means. The treated water discharged from the cell is filtered to remove additional non-nutrient suspended solids not entrained with the foam. A portion of the treated water from the electrolytic cell is recycled and reinjected into the influent stream. Control means are included to control residual chlorine in the effluent discharged while maintaining high dissolved oxygen in the effluent.
W80-06028

REMOVAL OF CYANIDE FROM WASTE WATER,
Societe Nationale Elf Aquitaine, Paris (France). (Assignee).
J-P. Bernat.
U.S. Patent No 4,179,348, 5 p, 1 Fig, 14 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 995, December 18, 1979.

Descriptors: *patents, *Waste water treatment, *Industrial wastes, *Separation techniques, Water pollution treatment, Electrodialysis, Membrane processes, Oxidation, Cyanides.

A method and device for eliminating the cyanide ion from waste water by anodic oxidation uses an electrodialyzer. Water enters the anode compartment of the dialyzer, which is separated from the cathode compartment by a semi-permeable diaphragm permable to cations; an alkaline solution travels through the cathode compartment. No reagent is added. Thus CN- is oxidized in the anodic region of the electrodialyser, and the cations which have travelled through the diaphragm are simultaneously discharged at the cathode. In this manner, the CN, ions are eliminated at the same time as the cations in the waste water, provided that the water for treatment flows through the anode compartment at a rate in proportion to the electric current flowing in the electrodialytic cell. In addition, the pH has to be monitored in the two

compartments. On the other hand, the auxiliary water conveyed through the cathode compartment is given a suitable salt content and pH for the cations to be dialysed in normal manner, the cations being discharged at the cathode. (Sinha-OEIS)
W80-06029

RESEARCH ON NOVEL SOLVENT EXTRACTION SYSTEMS FOR INDUSTRIAL WATER REUSE.
Bend Research, Inc., OR.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207301, Price codes: A05 in paper copy, A01 in microfiche. Final Report to the Office of Water Research and Technology, October 1979. 93 p, 52 Fig, 7 Tab, 22 Ref. OWRT C-80033-R(8808)(1). 14-34-0001-8808.

Descriptors: *Solvent extraction, *Ion exchange, *Metals, *Separation techniques, Chromium, Cation exchange, Industrial water, *Water reuse, Water treatment.

The objective of this program is to develop solvent-impregnated microporous beads for the extraction of metal ions from industrial waste waters to yield reusable water. Several metal finishing waste streams were identified and investigated in preliminary studies. Various liquid ion-exchange agents were screened for each waste stream in order to find a satisfactory agent for use in the beads. Chromium, nickel, and acid-zinc plating rinse waters were selected as the most promising applications. The performance of the beads was substantially improved during the course of the contract. Improvements included reduction of bead size, increased bead production rate, and development of beads from different polymers. Several bead column optimization studies were performed, which were designed to improve metal capacity or kinetics. It was found that the chemical nature of the diluent significantly influenced extraction kinetics. The concentration of active agent in the agent-diluent mixture was also significant. Although the beads are in an early stage of development, they compare favorably with a cation-exchange resin in the treatment of a synthetic nickel plating solution. Beads developed for chromium removal exhibit rapid exchange kinetics, but a low total capacity.
W80-06032

INDUSTRIAL WATER REUSE WITH COUPLED TRANSPORT MEMBRANES.
Bend Research, Inc., OR.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-206014, Price codes: A05 in paper copy, A01 in microfiche. Final Report to the Office of Water Research and Technology, September 1979. 91 p, 51 Fig, 6 Tab, 12 Ref. OWRT C-80139-R(8802)(1). 14-34-0001-8802.

Descriptors: *Ion transport, *Membrane processes, *Metals, *Separation techniques, Membranes, Water purification, Chromium, Copper, Industrial water, Water reuse, Water treatment, Ion exchange.

The objective of this program is to develop coupled transport membranes for the treatment of industrial wastewaters, allowing water reuse. Several metal-containing waste streams from the primary metals industry were identified as potential candidates for the application of coupled transport membranes. These membranes consist of a liquid ion-exchange agent constrained within the pores of a microporous polymeric support, forming a liquid membrane. Coupled transport was successfully demonstrated with flat sheet membranes for synthetic rinse solutions of chromium, zinc, and copper. Chromium was concentrated by a factor of nearly 10,000 from a dilute feed solution to a concentrated product solution, indicating excellent potential for recovery of a concentrated product. The composition of the diluent used to dilute the liquid ion-exchanger in the membrane had a major effect on the metal ion flux. The flux-limiting step in metal transport was determined to be membrane diffusion, rather than reaction kinetics. The most promising metal waste stream applications were also studied with hollow fiber membranes, which comprise a more favorable geometry for industrial application of coupled transport. Chromium and zinc exhibited the highest fluxes. The economics of coupled transport membranes for the recovery of metal values and reuse of rinse waters appears to be favorable.
W80-06033

WATER QUALITY CONTROL AND MANAGEMENT OF ANIMAL WASTES THROUGH CULTURE WITH SELECTED FISHES,
Illinois Natural History Survey, Urbana.
D. H. Buck, and R. J. Baur.
Available from the National Technical Information Services as PB80-206188, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Center, University of Illinois, Research Report 151, April 1980. 118 p, 6 Fig, 35 Tab, 55 Ref. OWRT A-083-ILL(4), 14-34-001-8015.

Descriptors: *Biological treatment, *Waste treatment, *Carp, Fish, Primary productivity, Water pollution control, Water quality control, Animal wastes, Ponds, Chinese carp, Polyculture.

This study evaluated the contributions of four Chinese carps to the biological treatment of organically polluted waters. Results established that through consumption of large quantities of organic matter, both living (plankton, bacteria) and dead (detritus, feces), the four carps in proper densities can significantly improve the quality of organically polluted waters and that properly designed systems would have practical application for small communitis, livestock producers, and food processors. Four Chinese carps were added to the four oxidation ponds receiving swine wastes. The carps used were chosen for their feeding habits: the silver carp (Hypophthalmichthys molitrix) filters suspended materials; the bighead carp (Aristichthys nobilis) filters zooplankton; the grass carp (Ctenopharyngodon idella) ingests coarse vegetation; the common carp (Cyprinus carpio) consumes benthos and detritus including fish feces. The study was conducted in four segments, spanning a total of four years, using different variables in each segment.
W80-06034

PROCESS FOR TREATING WASTE WATER,
Sumitomo Durez Co. Ltd., Tokyo (Japan). (Asignee).
E. Sumi.
U.S. Patent No 4,179,365, 4 p, 1 Tab, 11 Ref; Official Gazette of the United States patent Office, Vol 989, No 3, p 1000, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water polllution treatment, Organic wastes, Phenols, Separation techniques, Activated sludge, Microorganisms.

A process treats waste liquor or waste water containing phenols by means of activated sludge. Excess free phenols essentially harmful to aerobic bacteria and fungi present in the activated sludge are removed by means of a phenol recovery plant. The resulting effluent is treated in a large conditioning tank bringing the resulting liquor in contact with activated sludge, preferably under a low BOD load, to obtain a clan trated water through the function of microorganisms. The treated water is recycled to a large conditioning tank thereby achieving preliminary treatment of the waste water, an approach toward a closed system treatment of waste water. (Sinha-OEIS)
W80-06036

METHOD FOR THE BIOLOGICAL PURIFICATION OF EFFLUENT AND THE PLANT FOR CARRYING OUT THE PROCESS,
Union Carbide Corp., New York. (Assignee).
J. R. Kaelin.
U.S. Patent No 4,179,366, 7 p, 4 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 1000, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Water purification, Oxygen, Oxygenation, Activated sludge, Equipment, Flow.

Effluent to be biological purified is poured serially through three interconnected tanks with the first two tanks acting as activation tanks and the last tank acting as a post-clarification tank. After the concentration of activated sludge in the first tank has dropped to a predetermined value, the flow through the tanks is reversed so that the last tank, previously the post clarification tank, acts as one of the activation tanks and the first tank, previously one of the activation tanks, acts as the post clarification tank, which the middle tank continues to operate as the other of the activation tanks. An aerator is provided in each tank and the aerators in the first and last tanks are switched on or off depending upon the direction of flow of effluent. (Sinha - OEIS)
W80-06059

POLYMER TO AGGLOMERATE RESOLVED EMULSIONS,
Nalco Chemical Co., Oak Brook, IL. (Assignee).
R. L. Bradley, and F. A. Mauceri.
U.S. Patent No. 4,179,369, 6 p, 1 Fig, 2 Tab, 2 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 1001, /December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial wastes, Oil pollution, Emulsions, Separation techniques, Oil recovery.

A method of resolving a water-in-oil sludge (emulsion) to separate an oil phase and a water phase, comprises the steps of treating the sludge while being agitated with a demulsifying agent to break the emulsion and an acrylamide polymer to hold the separate phases resolved. (Sinah-OEIS)
W80-06065

ASSESSMENT OF SEWAGE LAGOONS AS POTENTIAL FISH CULTURE SITES IN WEST CENTRAL WISCONSIN,
Wisconsin Univ.-LaCrosse. Dept. of Biology.
S. P. AveLallemant, and J. W. Held.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204662, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Cener, University of Wisconsin, Madison Technical Report WIS WRC 80-10, 1980. 83 p, 1 Fig, 41 Tab, 101 Ref. OWRT-A-078-WIS(1), 14-34-0001-8053, 14-34-0001-9053

Descriptors: *Waste water, *Sewage effluents, Effluents, *Waste water treatment, Oxidation lagoons, *Sewage lagoons, *Aquicultue, Minnows, Fish farming, Bait fishing, Lagoons.

The potential of wastewate treatment lagoons in Wisconsin for culturing fathead minnows (Pimphales promelas) was considered. The efficacy of this treatment strategy in terms of improving effluent water quality by reclaiming nutrients in the form of fish biomass and reducing treatment costs by providing marktable bait fish was assessed. Wastewater lagoon systems located in 19 counties in west-central Wisconsin were assessed as potential fish culture sites during 1978 and 1979. Decisions were based on field masurements of temperatue and dissolved oxygen (DO), number of lagoons, loading rates, and 24-hr, on-site cage bioassays with fathead minnows. Water samples for chemical and phytoplankton analyses were collected every 2 weeks from May through September at 10 of the facilities during 1979. Successful fish culture in wastewater treatment lagoons appears to depend on the loading rate and design capacity of the facilities considered. High levels of amonia-nitrogen and low levels of DO were major limitations to fish culture in sewage lagoons. Characteristis of lagoon systems with a high probability of culture success include moderate loading rates, pretreatment of waste, and aeration. Fish culture in wastewater lagoons may provide a harvestable by-product which could help offset operating costs.
W80-06076

DEVICE FOR PURIFICATION OF LIQUIDS,

L. A. H. Hakansson.
U.S. Patent No 4,179,376, 5 p, 1 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 1004, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Industrial wastes, *Water pollution treatment, Separation techniques, Flocculation, Chemical precipitation, Filtration, Equipment, Filters.

A device for purification of liquids, especially waste water from industrial processes includes a flocculation chamber having means for a supply of a flocculant, a precipitation or sedimentation chamber for separation of the precipitate and a filter unit for further purification. The filter unit is arranged as an annular filter array having substantially radially arranged, inclined lamellas and is slidably and rotatably arranged on a vertical outlet tube in the precipitation or sedimentation chamber. The filter array is provided with a float member which keeps it in predetermind height relative to the surface of the liquid. The flocculation chamber comprises an annular, upwardly open channel and is arranged around the filter array. A cylindrical casing having apertures is arranged between the filter array and the annular flocculation chamber and is arranged to slowly rotate around the outlet tube so that the filter array follows the casing in its rotational movement. (Sinha-OEIS)
W80-06172

PROCESS AND APPARATUS FOR WASTE WATER TREATMENT,
Mitsubishi Rayon Co. Ltd., Tokyo (Japan). (Assignee).
H. Onishi, R. Numazawa, and H. Takeda.
U.S. Patent No 4,181,604, 7 p, 2 Fig, 2 Tab, 3 Ref; Official Gazette of the United States Patent Office, Vol 990, No 1, p 248, January 1, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Organic wastes, Biological treatment, Aerobic bacteria, Microorganisms, Oxygen, Equipment, Hollow fibers.

Waste water containing organic pollutants is purified by biological treatment with aerobic microorganisms supported on hollow fibers having microporous walls through which oxygen is supplied to the microorganisms. The hollow fibers have an outside diameter of 0.01-3 mm. The microorganisms are supported on the outside of the hollow fibers by introducing oxygen into the interior of them. Waste water is supplied to the exterior of the hollow fiber. (Sinha-OEIS)
W80-06179

VACUUM SEWAGE SYSTEM,
Burton Mechanical Contractors, Inc., Rochester, IN. (Assignee).
B. E. Foreman, and M. A. Jones.
U.S. Patent No 4, 179, 371, 6 p, 6 Fig, 2 Ref; Official Gazette of the United States Patent No 989, No 3 p 1001-1002, December 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Equipment, Flow, Sewerage, Vacuum systems.

The invention relates to sewage systems which utilize differential air pressure to create flow in contrasts to conventional gravity-operated and positive pressure sewer systems. The invention is directed to providing apparatus and a method for transporting a sewage mass from a source to a collection means. A pressure differential is maintained between them. Sewage is injected into a conduit and forms a hollow cylinder. When no sewage is being transported, the conduit has substantially the same pressure throughout. Injector means are provided which is a valve opened in response to a predetermined condition. (Sinha-OEIS)
W80-06181

APPARATUS FOR THE TREATMENT OF WASTEWATER,
Dravo Corp., Pittsburgh, PA. (Assignee).
E. S. Savage, and J. J. Chen.
U.S. Patent No 4,179,374, 7 p, 2 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 1003, December 18, 1979.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Anaerobic conditions, Denitrification, Nitrates, Oxidation, Filters, Equipment.

An apparatus for the treatment of wastewater has an enclosed unit providing a facultative zone where a mixture low in dissolved carbon comprising raw sewage and partially processed sewage undergoes denitrification brought about by facultative organisms contained in the prevailing low oxygen environment. Effluent from the facultative zone is charged into an enclosed columnar oxidation unit where a controlled flow of air or oxygen oxidizes nitrogen compounds present in raw sewage into nitrates. Part of the effluent from this columnar oxidation unit, where the limited flow of oxygen has been mostly consumed in oxidizing the nitrogen compounds and is low in dissolved oxygen, is recycled to the facultative zone and part flows into a columnar denitrification zone where anaerobic microorganisms substantially completely remove nitrogen as gas from the nitrates producing an effluent with a low nitrate content. Columnar oxidation units and denitrification units are in essentially deep-bed filters. Also the facultative zone is provided in a columnar unit. (Sinha-OEIS)
W80-06193

5E. Ultimate Disposal Of Wastes

REGIONAL GROUND WATER FLOW NEAR A HIGH-LEVEL RADIOACTIVE WASTE REPOSITORY,
Dames and Moore, Los Angeles, CA.
For primary bibliographic entry see Field 2F.
W80-06018

A MODEL TO ASSESS MIGRATION FROM SHALLOW LAND BURIAL FACILITIES,
Dames and Moore, Los Angeles, CA.
For primary bibliographic entry see Field 7C.
W80-06019

POTENTIAL SUBSURFACE ZONES FOR LIQUID-WASTE STORAGE IN FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. A. Miller.
Florida Bureau of Geology Map Series 94, 1979. 1 Sheet, 4 Fig, 9 Ref.

Descriptors: *Subsurface mapping, *Liquid wastes, *Underground waste disposal, *Waste storage, *Florida, Injection wells, Deep wells, Aquifers, Hdyrogeology, Saline water, Aquitards, Planning.

Deep-well injection of liquid wastes into saline aquifers in Florida can be an alternative to surface disposal in some areas. However, conditions for deep-well injection are not suitable everywhere. General subsurface geohydrologic conditions are described for the State of Florida, and areas are delineated where subsurface zones occur that appear capable of accepting injection from a single deep well at a rate of 1 million gallons per day without excessive pressure buildup in the receiving zone or injection well. All zones mapped contain water with a dissolved-solids concentration greater than 10,000 milligrams per liter and are bounded above and below by low-permeability materials. The northern and central peninsular parts of Florida are the least suitable areas for waste injection. In the western panhandle of the State, an extensive sand of low to moderate permeability is a potential injection zone. In southern peninsular Florida, two high permeability zones found in carbonate rocks extend over large areas and, where they contain saline water, are the most suitable injection zones in the State. (Kosco-USGS)
W80-06057

5F. Water Treatment and Quality Alteration

WATER TREATMENT FOR SMALL PUBLIC SUPPLIES,
New Mexico Water Resources Research Inst., Las Cruces.
H. G. Folster, D. B. Wilson, S. Hanson, and R. Duran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202930, Price codes: A04 in paper copy, A01 in microfiche. WRRI Report No 119, February 1980. 54 p, 10 Tab, 4 Append. OWRT T-0009(7515)(3).

Descriptors: *Water treatment, *Reverse osmosis, *Electrodialysis, *Desalination processes, *Chemical precipitation, Conductivity, Salinity, New Mexico, Heavy metals, Cadmium, Mercury, Zinc, Equipment, Variability.

Reverse osmosis and electrodialysis water treatment techniques were applied to saline water in San Jon and Alamogordo, New Mexico. Laboratory studies of selective cation removal by precipitation to remove trace heavy metals in water supplies were continued. The mobil van unit containing the water treatment equipment was moved from San Jon to Alamogordo. Electrodialysis of water at San Jon reduced the salinity from 1000 ppm to 87 ppm, and reverse osmosis decreased the conductivity from 1300 to 220 (SW, spiral wound nodule)/ 30 (HFF, hollow fine fiber). Water recovery after the treatment processes ranged from 78 to 85%. Desalting at Alamogordo reduced the salinity from about 1300 ppm to about 78 ppm and reverse osmosis reduced the conductivity from about 1880 to 130 (SW)/120 (HFF). Sulfide precipitation of heavy metal cations (cadmium, mercury, and zinc) was performed on the water samples and analysis of variance or F-tests were carried out for each set of rate data. Precipitation rate was found to be most significant at pH 9 and an increase in temperature above 10 degrees C reduced the precipitation rate. All of the chemical analyses and operation logs of both locations are reported in tabular form. (Sidney-IPA)
W80-06007

A LAYMAN'S GUIDE TO IRON BACTERIA PROBLEMS IN WELLS,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5C.
W80-06016

THE APPROPRIATE TECHNOLOGY OF PROMOTING SAFE WATER SUPPLY IN AFRICA,
Ahmadu Bello Univ., Zaria (Nigeria).
B. Z. Diamant.
Aqua, No 3, p 0047-0049, 1980. 1 Tab, 17 Ref.

Descriptors: *Water supply development, *Public health, *Safety, *Water quality, Water purification, Waste water treatment, Sewage treatment, Technology, Planning, Decision making, Political aspects, Filtration, Chlorination, Social aspects, Irrigation, Wells, Monitoring, Maintenance, *Africa.

Possible solutions and factors influencing the development of safe water supplies in Africa are discussed. Safe water is a major issue in Africa and it is estimated that only 1 out of 3 African rural people will drink disease-free water in 1980. The problem mainly affects the rural areas where 83% of the African people live. The planning of safe water supply development should take into account national policy, sociological considerations, simultaneous approaches, water supply, water treatment, and surveillance. National policy should involve simultaneous programs of safe water and adequate waste disposal. The appropriate technology should be employed such as simple hand pumps and shallow dug wells so that the people will accept it and be able to easily operate the equipment. Roof catchments of corrugated metal are excellent for collecting safe drinking water and also for improving housing. Proper waste disposal programs are necessary to prevent contamination

of the water supply. Waste water can be used effectively in most cases for crop irrigation. Slow sand filtration and bleaching powder chlorination are simple forms of water treatment. The success of a safe water development program will also depend on effective surveillance, health checks and maintenance. (Sidney-IPA)
W80-06119

WATER SOFTENING SYSTEM,
J. W. Braswell.
U.S. Patent No 4,181,605, 10 p, 10 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 990, No 1, p 248-249, January 1, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, *Water softening, Ion exchange, Resins, Control systems, Instrumentation, Waste dilution, Regeneration.

The water softening system employs a treatment tank containing a mineral bed of ion-exchange resin granules, a brine tank, and a a valve for periodically cycling water throgh the mineral bed for removing hardness and other undesirable factors. A diluted brine solution is passed through the bed in an opposite direction to its normal service flow to recondition and flush the bed. The control for the system includes electrically operated solenoid diaphram valves, and a plunger valve responsive to water pressures, for controlling and regulating the flow of water and brine through the mineral bed. A venturi aspirator is incorporated in the plunger valve whereby a saturated brine solution is drawn and with controlled dilution is caused to flow in a direction opposite to service flow through the mineral bed. (Sinha-OEIS)
W80-06180

5G. Water Quality Control

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6E.
W80-06002

MANAGEMENT MODEL OF A GROUND WATER SYSTEM WITH A TRANSIENT POLLUTANT SOURCE,
Stanford Univ., CA. Dept. of Geology.
S. M. Gorelick, I. Remson, and R. W. Cottle.
Water Resources Research, Vol 15, No 5, p 1243-1249, October, 1979. 6 Fig, 1 Tab, 12 Ref, 1 Append.

Descriptors: *Water management(Applied), *Ground water, *Water quality, *Computer models, Pollutants, Approximation method, Water supply, Waste disposal, *Aquifer management.

This paper describes an aquifer management model to determine the maximum concentration allowable at a transient pollutant source to meet space-dependent ground water quality requirements. The model is demonstrated using a one-dimensional ground water system with a single pollutant source at an adjacent stream for single-period and repeated-period pollutant discharges. The Crank-Nicolson numerical approximation of the convective-dispersive equation is used in the management model. The pollutant source concentration is treated as a parameter in the resulting system of linear equations. The concentrations throughout the system are defined and manipulated as functions of this parameter for each time step. The parameter is maximized by comparison of ground water quality limits with the ground water solute concentration at the corresponding nodes. The final value of the parameter is the maximum concentration allowable in the source water over the management period. The model is conceptually applicable to more complicated one-dimensional and two-dimensional problems. Any numerical approximation that generates a system of linear equations may be incorporated into the pollutant source model. The model enables ground water managers to balance water supply and waste disposal needs while maintaining quality over long periods. (Purdin-NWWA)
W80-06015

EVALUATION OF INDUCED INFILTRATION BETWEEN THE RIVER SKERNE AND THE MAGNESIAN LIMESTONE IN SOUTH EAST DURHAM,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W80-06020

GROUND WATER POLLUTION BY SEPTIC TANK DRAIN FIELDS,
Washington Univ., Seattle. Dept. of Environmental Health.
F. B. DeWalle, and R. M. Schaff.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 631-648, June, 1980. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Water pollution, *Ground water, *Septic tanks, *Soil disposal fields, Washington, Sampling, Chemical analysis, Surface water, Correlation analysis, Coliforms, Pollutants, Cation exchange, Water quality.

This paper presents the results of a study on ground-water contamination by septic tank effluent in Central Pierce County, Washington. Chemical analyses were collected on 386 ground water samples from 98 wells with depths ranging from 210 feet to 1,064 feet and yields ranging from 10 gpm to 3,500 gpm. A correlational analysis showed high correlations among calcium, magnesium and bicarbonate and low values among nitrate, chloride, and sodium reflecting sewage effluent contamination. In unsewered areas with high septic tank density a negative correlation was noted between calcium and sodium, possibly indicating a cation exchange. This hypothesis is supported by the observation that, over a 30-year period, there was a gradual increase of calcium and chloride concentration and an almost constant sodium content. Depth profiles similarly showed low sodium concentrations at all depths but high calcium and nitrate concentrations near the surface, decreasing to lower values at depth. The highest nitrate and coliform concentrations occur in the winter when infiltrating precipitation dissolves and leaches these contaminants downward. Restricting septic tank installation in densely populated areas will probably reduce the rate of ground water deterioration. (Purdin-NWWA)
W80-06023

REGULATORY AND ENVIRONMENTAL IMPLICATIONS OF GROUND WATER HEAT PUMPS,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 6E.
W80-06030

MICROBIOLOGICAL ASSESSMENT OF RIVER WATER CONTAMINATION BY FISH HATCHERY EFFLUENT,
Oregon State Univ., Corvallis. Water Resources Research Inst.
J. C. Leong, and J. L. Fryer.
Report WRRI 66, March 1980. 165 p. OWRT C-7620(No 7251)(1), 14-34-0001-7251.

Descriptors: *Fish diseases, *Fish hatcheries, Hatchery effluent, *Viruses, Virus detection, *Salmonoids, Fish casualties, Water quality, Water pollution sources.

Since 1973, there has been at least one major viral epizootic at an Oregon fish hatchery each year. This research proposal is concerned with the microbiological quality of the water released into the Oregon watershed after a viral epizootic and the impact of releasing this virus-containing water on environment. The following research accomplishments were made: (1) Development of methods for concentrating IHNV and IPNV from water by polymer two-phase separation and graduated pore-size membrane filtration, (2) Development of methods to increase the sensitivity of laboratory methods for detecting IHNV and IPNV by proper host cell selection and pretreatment of cells with polybrene, (3) Development of models for the virus-carrier state in vitro, (4) Demonstration that IHNV will grow in mosquito cells. This result suggests an insect vector for IHNV transmission, (5) Demonstration that IHNV will grow in mammalian cells at 16 C. However, no phenotypic mixing was observed in cell cultures doubly infected with VSV and IHNV, (6) U.V. irradiation of virus-containing water was effective in eliminating IHNV and IPNV from the water in a flow-through system, and (7) Quantitation of the virus released in hatchery effluent water during an IHNV epizootic. This study has shown that large quantities of virus are released into the environment during spawning of infected fish and during a viral epizootic. This virus-contaminated water can be a contributing factor in maintenance and enlargement of a virus-carrier population of fish in the wild.
W80-06083

FLOTATION PUMP DEVICE,
R. J. Aide.
U.S. Patent No 4,179,243, 6 p, 3 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 989, No 3, p 963-964, December 18, 1979.

Descriptors: *Patents, *Aeration, *Water treatment, *Equipment, Water quality control, Pumps, Bodies of water, Lakes, Pumping.

The invention relates to aerating devices for aerating lakes, ponds, and reservoirs and the like. A pumping device is provided which has a telescoping pipe structure for pumping water from the bottom of a lake up to the surface of the lake. The telescoping pipe is pivotally mounted to a raft to pivot from horizontal to a vertical position so that the device may be installed into the lake by moving the raft and telescoping structure out onto the lake while the pipe is horizontal and then allowing the pipe to pivot to a vertical position when the raft has reached the desired location in the lake for pumping. (Sinha-OEIS)
W80-06124

6. WATER RESOURCES PLANNING

6B. Evaluation Process

DEMONSTRATION OF AN ANALYTIC MODEL FOR ESTABLISHING WATER RESOURCES DEVELOPMENT PRIORITIES,
Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
G. W. Reid, and T. W. K. Leung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-204449, Price codes: A04 in paper copy, A01 in microfiche. Report, September 1979. 70 p, 28 Fig, 17 Tab, 16 Ref. OWRT A-089-OKLA(1).

Descriptors: *Priorities, *Water development, *Decision making, *Indexing, Economic feasibility, Legisltion, resources development, Cost-benefit analysis, State governments, Economic justification, Environmental effects, Planning, Impoundments, Budgeting, Comprehensive planning.

A priority system for Oklahoma water resource development projects based on an anlytical model is reported. Single Index and Double Index Approaches were used to develop the priority listings which may be very useful for the State decision maker in the funding of proposed water resources projects. Seven arbitrarily selected water projects (five impoundments and two water treatment facilities) with adequate pertinent data were used for this study. Groundwater development projects were not included because they seldom contain enough useful data for decisions to be based on and the environmental assessment of such projects is quite controversial. Some initial computation was

necessary to convert the data from the projects into a usable form. From the data, a single composition score or priority index was generated by the Single Index Approach. Two indices, a demand index and a desirability index were given by the Double Index Approach and several cluster groups of projects were formd. The later approach seems most useful, the model is flexible, and it appears that project type or size has no effect on the priority ranking. Data availability is critical for complete priority assessment. (Sidney-IPA)
W80-06008

WATER RESOURCE PRESERVATION: PERSONAL VALUES AND PUBLIC SUPPORT,
Washington State Univ., Pullman. Dept. of Political Science.
J. C. Pierce.
Environment and Behavior, Vol 11, No 2, p 147-161, June 1979, 3 Tab, 26 Ref. OWRT-A-069-WASH(5), 14-31-0001-5048.

Descriptors: *Water resources, *Preservation, *Aesthetics, *Social values, *Attitudinal surveys, Conservation, Social aspects, Surveys, *Washington, Value, Water conservation, Public sector, Environment, Attitudes, Behavior, Motivation, Psychological aspects.

This article relates individual's personal values to their support for water resources preservation; results are dominated by a single-value-a world of beauty. Preference for a world of beauty enters into calculations of most types of people when supporting or opposing environmental quality. Results suggest shared value perceptions implied by environmental policy. However, a substantial portion of the variance in support for preservation remains unexplained. Separate analyses are required to assess these idiosyncratic value relationships with environmental policy alternatives. The relationship between personal values and support for water resources preservation was assessed from data obtained in a mail questionnaire survey of household heads in Washington State in 1974. Seven possible water use priorities were identified: agriculture, preservation, domestic, energy, industry, recreation, and transportation. Personal values were measured by the Milton Rokeach inventory. Water policy self-interest measures such as waterfront property ownership and water resource use level were also included. Public orientations to water resource preservation are related to personal values. Values also more consistently relate to preservation support among individuals with greater self-interest in water resource policy. (Danovich-Wisconsin)
W80-06043

PRESENT METHODS AND PROSPECTIVES IN WATER METER READING AND BILLING (METHODES ACTUELLES ET PROSPECTIVES EN MATIERE DE RELEVE DES COMPTEURS ET DE FACTURATION DES CONSOMMATIONS D'EAU),
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
A. Desmed.
Aqua, No 3, p 0055-0065, 1980. 3 Fig, 41 Ref. (English Summary).

Descriptors: *Water measurement, *Optimization, *Instrumentation, *Automatic control, Water rates, Measurement, Cost-benefit analysis, Water costs, Wages, Decision making, Management, Economics, Projections, Planning, Cost repayment, Maintenance costs, Social aspects.

Several methods for the optimization of water meter reading and billing are discussed. The cost of remote meter reading and automatic meter reading is high, but a reduction in cost could result if water, gas, and electric meters were grouped together in one system. Manual reading costs have continued to increase because of wage increases and optimization of this system would entail cutbacks in the number of meters read, number of readings, and the institution of consumer self-reading. Efficiency could also be improved with complete automation in all aspects of data processing: reading, billing, and collection. The determination of management thresholds will also be necessary to establish the economics of the available reading and billing methods, choice of water meters, methods of record keeping, frequency of reading, and maintenance. An automatic control system would be economically justified if the sum of the probability of an error time the consequences of the error was greater than the cost of the system. Decision makers should also pay special attention to the quality of service in relationship to the management techniques employed. (Sidney-IPA)
W80-06120

OPTIMUM MANAGEMENT OF WATER METERS: WAYS AND MEANS,
Societe Lyonnaise des Eaux et de l'Eclairage (France).
J-F. Bost.
Aqua, No 3, p 0066-0068, 1980. 7 Fig.

Descriptors: *Water measurement, *Instrumentation, *Optimization, *Management, Water rates, Flow, Economics, Performance, Reliability, Water utilization, Planning, Variability, Cost-benefit analysis, Maintenance costs, Water meters.

The precision of five types of volume water meters in five large urban areas in France was investigated to develop an optimized management policy for each water distribution system. Errors in the meter reading result from very low flow rates, leaks, differences between various models, or aging of the instrument. These factors tend to give an underestimation of the actual water consumption. At high flowrates (above 320 liters per hour), the age of the meter influenced the measurement error. About 7% of the water consumption was not measured because the flow was too low to be recorded. Replacement of old meters after more than ten years of service may be justified, but marginally economical. More tests of the influence of jammed meters and flowrates below 320 liters per hour will be performed in the future. (Sidney-IPA)
W80-06121

PUBLIC ATTITUDES TOWARD THE RECREATIONAL USE OF DRINKING WATER RESERVOIRS IN MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning.
L. R. Klar, Jr., W. H. Bumgardner, and A. Ghirin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207509, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts Publication No 114, 1980. 72 p, 26 Tab, 23 Ref, 1 Append. OWRT A-107-MASS(1). 14-34-0001-9023.

Descriptors: *Multiple purpose reservoirs, *Recreation facilities, *Effects, *Water quality, *Potable water, Outdoor recreation, Outdoor recreation planning, Drinking water reservoirs, Quabbin reservoir, Recreation demand, Recreation user characteristics, Outdoor recreation policy, *Reservoir management, Recreation participation, Willingness to pay, Telephone survey, Water quality, Social survey, Drinking water managers.

This study identified public attitudes among Massachusetts residents toward the recreational use of drinking water reservoirs including Quabbin Reservation, the state's largest water supply source. Results were compared to the findings of two related studies on the same topic. The first assessed attitudes among recreational users of Quabbin Reservation and the second surveyed attitudes of water supply managers. Data for this study were obtained through telephone interviews with 961 randomly selected adults throughout the state. Most people favored a moderate recreational use-level of reservoirs and support was expressed by a majority of respondents for a number of activities which are presently not allowed at Quabbin. Only 6 activities were not favored by a majority. Those classified as Quabbin users were especially in favor of certain activities. A majority of respondents stated that state funds should be used to finance recreation at drinking water reservoirs and that user fees were also appropriate. Paying a slight increase in water bills was not seen as a viable funding method. There is a need to study current policies governing recreation at drinking water reservoirs in Massachusetts. The recreation carrying capacity of these resources should be studied to determine if present use levels can be increased without altering present treatment practices.
W80-06157

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DESALTING HANDBOOK FOR PLANNERS.
Catalytic, Inc., Philadelphia, PA.
For primary bibliographic entry see Field 3A.
W80-06013

EFFICIENCY AND EQUITY IN MANAGEMENT OF AGRICULTURAL WATER SUPPLIES,
California Univ., Davis. Dept. of Agricultural Economics.
R. E. Howitt, W. C. Watson, and C. F. Nuckton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207699, Price codes: A03 in paper copy, A01 in microfiche. Giannini Foundation of Agricultual Economics, Information Series 79-1 Bulletin 1892, March 1979. 29 p, 3 Fig, 3 Tab, 2 Append. (California Water Resources Center Project UCAL-WRC-W-526). OWRT-B-187-CAL(03).

Descriptors: *Agriculture, *Economics, *Mathematical models, *Groundwater, *Surface water, *Water supply, *Crop production, *Water costs, California, Irrigation efficiency, land, Energy, Water.

This quadratic programming model is an irrigation orientated extension of a model developed by Adams, King, and Johnston and considers a possible 370 production activitis for nine field crops and 28 seasonal vegetable crops. The state of California is divided into 14 production regions each with two irrigable soil types. The regions are based on homogeneity of climate, soil type, and water costs and availability. Regional production activities are constrained by the physial availability of land, water, and, in a few cases, by processing capacity. maximum statewide production is also constrained for all commodities. Data on yields and production costs are from University of California Agricultural Extension Service estimates. Perennial crops are not included in the model, but the available amounts of ground and surface water in the model were adjusted regionally to allow for perennial requirements. This additional constriction is consistent with state and federal water allocation policy decisions made in 1977. The model's objective function of maximizing consumers' surplus and producers' quasi-rent yields the optimum crop mix subject to constrained amounts of land, energy, and water. (Snyder-California).
W80-06081

CROP PRODUCTION AND WATER SUPPLY CHARACTERISTICS OF KERN COUNTY,
California Univ., Davis. Dept. of Agricultural Economics.
W. D. Watson, C. F. Nuckton, and R. E. Howitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-205552, Price codes: A06 in paper copy, A01 in microfiche. Giannini Foundation of Agricultural Economics, Information Series 80-1 Bulletin 1895, April 1980. 96 p, 19 Tab, 4 Plates, 1 Append. (California Water Resources Center Project UCAL-WRC-W-526). OWRT-B-187-CAL(4).

Descriptors: *Water supply, Agriculture, *Crop production, *Economics, *Irrigation, *Water costs, *Available water, Walter quality, California, *Kern County(CA).

An account of agricultural production in Kern county, California, is given in this report, with particular emphasis on that all-important component-water for irrigation. We have brought together in one place an abundance of informatin accu-

mulated over a two year period from many and diverse sources. The collection and arrangement of the data should prove directly useful to Kern County planners. It may also serve a broader purpose, for kern County water probems and possible solutions are paradigmatic of those in other parts of this semi-arid state in the not-too-distant future. The analysis of the water supply situation and water costs in Kern County, therefore, merits the attention of state-level warer strategists. Informatin was gathered both from published sources and from conversations with many experts. The historical framwork of Kern County agriculture can be viewed as a series of production stabilization plateaus, for whenever the available water supply became a binding constraint, no additional acreage was irrigated. Then as more water became available, expansion occurred. Feasibility studies made prior to supplemental water projects and post-project evaluations were a main source of information. (Snyder-California)
W80-06082

6E. Water Law and Institutions

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS,
Connecticut Univ., Storrs. Inst. of Water Resources.
M. M. Huffmire, and F. C. Reitman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202484, Price codes: A02 in paper copy, A01 in microfiche. Research Project Technical Completion Report, 1979. 19 p. OWRT A-082-CONN(1). 14-34-0001-9007.

Descriptors: *Aquifers, *Ground water, *Aquifer protection, *Aquifer recharge areas, Aquifer management, Planning, *Connecticut, *Land use controls, *Cost-benefit analysis.

Evidence indicates that many of Connecticut's high yield aquifers are already contaminated and that without immediate action to restrict harmful surface practices, they will be followed by others. Economic evidence indicates that the State as a whole can reap substantial benefits by an intelligently conceived and implemented program of land use monitoring and water resource planning, but that such a program can only be undertaken through additional legislation and funding. Current legal mechanisms for the orderly management of water resources are insufficient and need overhaul. Greater stress must be placed on long-term planning on the regional level, and strong institutional arrangements to implement this planning process are necessary.
W80-06002

REGULATORY AND ENVIRONMENTAL IMPLICATIONS OF GROUND WATER HEAT PUMPS,
National Water Well Association, Worthington, OH.
T. E. Gass.
Water Well Journal, Vol 34, No 6, p 26-28, June, 1980. 1 Fig, 1 Tab.

Descriptors: *Heat pump, *Regulation, *Environmental effects, *Ground water, Effluents, Waste water disposal, Injection wells, Underground waste disposal, State governments, Local governments, Computer programs, Model studies, Aquifers, Heating, Cooling, Thermal pollution, Water quality, Water chemistry, On-site investigations.

Regulations affecting the use of ground water heat pumps impose various requirements on well construction, ground water use and quality, and effluent disposal. Discharge of thermally altered water to surface water is regulated by the National Pollutant Discharge Elimination System while discharge to wells falls under the Federal Underground Injection Control Program. Ground water use regulations do not significantly affect heat pump growth. However, state and local regulations may impose severe restrictions on ground water heat pump use. The National Water Well Association and the National Association of State Legislators are working with state officials to change existing regulations. The EPA awarded a contract to NWWA to assess the environmental implications of widespread ground water heat pump use. A computer program was developed to simulate the long-term thermal impact on nearly every type of hydrogeologic environment and with any heating and cooling loads. Temperature changes vary from 10 degree F within 10 feet of the return well to 1 degree F at a distance of 100 feet. If the ground water heat pump is used for both heating and cooling, the extent and degree of temperature alteration are greatly reduced. Changes in ground water quality and viscosity were not detected in a field demonstration. (Purdin-NWWA)
W80-06030

EFFICIENCY AND EQUITY IN MANAGEMENT OF AGRICULTURAL WATER SUPPLIES,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W80-06081

CROP PRODUCTION AND WATER SUPPLY CHARACTERISTICS OF KERN COUNTY,
California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W80-06082

6F. Nonstructural Alternatives

THE IMPACT OF NONSTRUCTURAL FLOOD ABATEMENT MEASURES ON PATTERNS OF INDUSTRIAL LOCATION,
Shippensburg State Coll., PA. Dept. of Economics and Management Science.
D. D. Singer, and J. W. Kohn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202526, Price codes: A07 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources The Pennsylvania State University University Park. Research Project Technical Completion Report, June 1980, 123 p, 6 Fig, 20 Tab, 88 Ref. OWRT A-052-PA(1). 14-34-0001-9040.

Descriptors: *Flood plains, *Floods, *Industries, *Abatement, Model studies, Flood damage, Stormflow, Rainfall, Streamflow, Runoff, Land use, Evapotranspiration, Groundwater, Population, Coal mines, *Susquehanna River Basin, *Simulation model, Computer program, Stage feet function, Damage function, Hydrologic characteristics, Stochastic analysis.

This report outlines the hydrologic and economic characteristics of the Susquehanna River Basin, and analyzes flood damages and the effect of nonstructural flood abatement measures. A new method of estimating flood damages is needed, since current methods do not allow for the actual nature of flood risk and are inherently biased against the use of nonstructural relative to structural flood damage abatement measures. Actual patterns of industrial location in the Susquehanna River Basin are examined, and modifications made to the theory of industrial location under the threat of flood. The report concludes that the location of an industrial facility in a flood plain reflects, under many circumstances, rational behavior on the part of the firm. Proximity to markets and rail transportation provide significant market economies for industry. Existing flood damage abatement systems rely excessively on structural relative to nonstructural measures; the greater use of nonstructural measures would reduce the risk associated with the location and encourage the industrial use of such land. (Tsong-Pa)
W80-06011

POST-FLOOD RECOVERY AND HAZARD MITIGATION: LESSONS FROM THE MASSACHUSETTS COAST, FEBRUARY, 1978,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
R. H. Platt, and G. M. McMullen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-207517, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center, University of Massachusetts Publication No. 115, 1980. 101 p, 4 Fig, 11 Tab, 44 Ref.

Descriptors: *Floods, *Floodplains, Coast, Natural hazard, Storms, Disaster, *Flood damge, *Flood plain insurance, Flood plain zoning, Hazards, Watershed protection and flood prevention act, Massachusetts, *Flood recovery help, Flood insurance.

Responsibility for response to flood disasters has historically evolved from reliance on privare, local and state efforts to a predominantly federal role. The federal government now expends billions of dollars annually for flood protection, emergency relief and long-term recovery. U.S. flood policy has emerged in thre stages: (1) the Structual Era; (2) Unified Floodplain Management; and (3) Post-Flood Mitigation. State 3, represents an integrated response to bloodplain management, utilizing structural and nonstructural controls, and focusing on the prevention of repetitive losses. The Great blizzard and Coastal Flooding of February 1978 was one of the most devastating natural disasters to strike New England in modern times. Although damage assessments vary widely, over 25,000 homes were affected and over 300 destroyed in Massachusetts. Private domstic losses were valued at $172.4 million; natural resource losses, $7 million; Federal Disaster Assistance Administration (FDAA) costs for coordination, relief, and recovery were $190 million. This diaster provided the opportunity to assess out national commitment to reducing flood losses. Federal, state and municipal programs for land acquisition/relocation, wetland protection and restriction, and post-disaster regulations fo reconstruction were tested. Despite the early optimism of some public officials, no 'high risk' coastal property was publicly acquired and no families were publicly relocated from disaster areas. Many of the affected structures were allowed to be rebuilt without elevation and floodproofing because they were deemd not to have sustained damage beyond 50% of their pre-storm fair market value. The Mass. Wetlands Protection Act yielded some mitigation benefits due to local Conservation Commission efforts.
W80-06156

6G. Ecologic Impact Of Water Development

ESTROGEN SEX REVERSAL OF TILAPIA AUREA,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 8I.
W80-06035

7. RESOURCES DATA

7A. Network Design

FLUID FLOW IN NATURALLY FRACTURED RESERVOIRS,
Rice Univ., Houston, TX. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W80-06024

7B. Data Acquisition

A FIELD EXERCISE ON GROUND WATER FLOW USING SEEPAGE METERS AND MINI-PIEZOMETERS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
D. R. Lee, and J. A. Cherry.
Journal of Geological Education, Vol 27, No 1, p 6-10, January, 1980. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Education, *Hydrogeology, *Ground water movement, *Piezometers, *Seep-

age, *Instrumentation, *On-site data collections, Water quality, Pollutants, Hydrologic data, Limnology, Lake beds, Streams, Estuaries, Surface-ground water relationships.

Basic principles of hydrogeology and surface-ground water relationships were clearly demonstrated to university students with the aid of two inexpensive devices: a miniature piezometer and a seepage meter. These two devices provide information on the flow net, the flux and velocity of water moving along the flow lines at and near the interface, and ground water quality. Student investigations can involve the identification of ground water inflow or outflow areas in lakes, streams, or estuaries, measurement of the spatial and temporal variations in seepage flux through bottom sediments, identification of zones of subsurface pollutant migration into surface waters, measurement of the ground water component of the water budget of a lake or pond, or the role of ground water in fluvial erosion and deposition. The construction and use of the mini-piezometers and seepage meters are described in detail. Construction materials can be acquired for less than 25 dollars. In a matter of a few hours, the devices can be installed, monitored, and removed. (Purdin-NWWA)
W80-06014

DRILL PROVIDES UNMIXED SAMPLES,
World Water, Vol 3, No 4, p 39, April, 1980. 1 Fig.

Descriptors: *Dual-tube drilling, *Rotary drilling, *Drilling samples, Water loss, Operating costs, Collapse.

A new rotary drilling method, dual-tube drilling, provides accurate data on potential yield of aquifers by drawing up unmixed continuous formation samples. In addition, it has lower operating costs and results in straighter holes with fewer washout zones. This method is based on the use of double-walled or concentric flush-jointed drill pipe. The hole-cleaning air or fluid is circulated down the annulus between the inner and outer pipes to the drill bit where it flushes the samples up through the center tube at high velocity. Since the outer tube supports the hole, surface casing can be eliminated. This system can maintain circulation even while drilling in caving or fractured strata. Dual-tube drilling can use a variety of rotary bits, but favors top-head drive rigs overrotary table rigs. The high penetration rates with this system results in lower costs. In some cases costs for drilling and sampling have been cut by 70 percent. (Purdin-NWWA)
W80-06045

DRAFT, CONSTRUCTION AND OPERATION OF A SEQUENTIAL RAIN SAMPLER,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
W. A. H. Asman.
Water, Air, and Soil Pollution, Vol 13, No 2, p 235-245, June 1980. 10 Fig, 2 Tab, 11 Ref.

Descriptors: *Sampling, *Chemistry of precipitation, Rainfall, Equipment, Design, Water chemistry, Rain gages, Rainfall intensity, Chemicals, Calcium, Chloride, Sodium, Nitrogen, Sulfur, Pollutants, path of pollutants, Water pollution, Sequential rain samplers.

Sequential sampling of rain on a volume basis presents fewer problems than sampling on a time basis. The optimum diamenter of the collector opening depends on the rainfall statistics, the size of the sample needed for chemical analysis, and the total number of samples that has to be collected. The sampler described in this paper consists of a square polyethylene funnel of 0.64 sq m and a fraction collector with 250 polypropylene tubes of 39 ml, which is activated by a rain detector. Each fraction corresponds to about 0.05 mm of rainfall. The funnel is covered by a roller blind that automatically rolls up when it starts to rain. Evaluation of the system leads to the conclusion that the collector opening can be made smaller (by 0.20 sq m), that the measured rainfall rate depends on the averaging time, and that all other surfaces of the sampling setup should be covered with inert material. (Sims-ISWS)
W80-06084

RAIN DROP SIZES AND RAINFALL RATE MEASURED BY DUAL-POLARIZATION RADAR,
Ruthrford and Appleton Lab., Slough (England).
M. P. M. Hall, S. M. Cherry, J. W. F. Goddard, and G. R. Kennedy.
Nature, Vol 285, No 5762, p 195-198, May 22, 1980. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Rainfall, *Radar, *Remote sensing, Particle size, Ice, Snow, Hail, Spatial distributions, Rainfall intensity, Equipment, Instrumentation, Mesurement, Meteorology, Dual-polarization radar.

A rapidly switched dual-polarization radar technique was used for the first time to obtain two-dimensinal spatial distributions of the statistical characteristics of the sizes and concentration of raindrops in rain. These were obtained using a high-resolution 10-cm wavelength radar, and the data were used to estimate rainfall rates within small volumes to a much greater accuracy than is available from conventional radar measurements. The technique also gave a clear distinction between ice particles and raindrops. (Sims-ISWS)
W80-06087

DIURNAL RAINFALL VARIATION IN NORTHEAST BRAZIL,
Conselho Nacional de Desenvolvinento Cientifico e Technologico, Rio de Janeiro (Brazil); and Instituto de Pesquisas Espaciais, Sao Jose dos Campso (Brazil).
For primary bibliographic entry see Field 2B.
W80-06094

PERFORMANE OF V.H.F. AERIALS CLOSE TO A SNOW SURFACE,
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 2C.
W80-06098

RUNOFF SYNTHESIS USING LANDSAT AND SCS MODEL,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-06131

A SAMPLER FOR COHESIVE SEDIMENT IN THE BENTHIC BOUNDARY LAYER,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
R. Bryant, D. J. A. Williams, and A. E. James.
Limnology and Oceanography, Vol 25, No 3, p 572-576, May 1980. 3 Fig, 3 Ref.

Descriptors: *Sampling, *Equipment, *Sediments, On-site tests, Instrumentation, Suspended solids, Foreign research, *Wales, Benthic boundary layer.

A sampling apparatus for collecting sediment suspensions from the benthic boundary layer has been developed and tested. Samples are collected in evacuated pressure-resistant bottles by activation of solenoid valves used to release the vacuum. The behavior of the apparatus with respect to water velocity was assessed from direction and inclinometer sensors attached to its main frame. The apparatus has been tested at a depth of 30 m in the Bristol Channel in water velocities of 1-2 m/s. Profiles of suspended sediment in the boundary layer were derived from gravimetric analysis of the samples collected. An important characteristic of the sampler is that under conditions of appreciable water movement, samples are collected from the oncoming water and not from a self-induced turbulent field. However, this would not be true in calm water. (Humphreys-ISWS)
W80-06132

AN AUTOMATED SYSTEM FOR MEASURING SOIL WATER POTENTIAL GRADIENTS IN A RHIZOTRON SOIL PROFILE,
Science and Education Administration, Auburn, AL.
For primary bibliographic entry see Field 2G.
W80-06185

PROFILE SOIL MOISTURE FROM SURFACE MEASUREMENTS,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W80-06200

7C. Evaluation, Processing and Publication

USER'S GUIDE TO UIMIP AND MTRX,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-202476, Price codes: A06 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, University of Idaho Partial Research Technical Completion Report, May 1980. 103 p, 4 Fig, 9 Ref, 4 Append. OWRT B-041-IDA(1).

Descriptors: *Linear programming, *Algorithms, *Computer programs, Programming languages, Data processing, Mathematical models, Operations research, Economics, Optimization.

A systematic discussion of the UIMIP integer linear programming program is presented in this user's manual. Users should have a basic knowledge of linear programming, mathematical programming, algorithms, and FORTRAN programming. Direct access files are used to reduce the computer memory size required for integer solutions and intermediate tableau and row and column identification tables are saved on a disk file during the integer solution. An integer programming problem as large as a continuous programming problem can be solved on a computer of a given size, but more CPU time is necessary for file assessment. A revised simplex method could cut down computing time and core size requirements. The organization of the program is described in detail and the four calling programs for subroutine (DEFINE FILE, DIMENSION, DOUBLE PRECISION, and DATA) are discussed. The data input formats, coding procedures and examples, and illustrations of a proper card deck are presented and guidelines for efficient use and error correction are included. A matrix generating program (MTRX) for UIMIP is available. Sample solutions for a small and a large sized problem are included. (Sidney-IPA)
W80-06006

MANAGEMENT MODEL OF A GROUND WATER SYSTEM WITH A TRANSIENT POLLUTANT SOURCE,
Stanford Univ., CA. Dept. of Geology.
For primary bibliographic entry see Field 5G.
W80-06015

A MODEL TO ASSESS MIGRATION FROM SHALLOW LAND BURIAL FACILITIES,
Dames and Moore, Los Angeles, CA.
O. I. Oztunali, and A. E. Aikens.
Dames and Moore Engineering Bulletin 50, p 21-30, December, 1979. 4 Fig, 7 Tab, 6 Ref, 1 Append.

Descriptors: *Computer models, *Radioactive waste disposal, *Landfills, *Mass transfer, Migration, Hazardous wastes, Radioisotopes, Aquifer characteristics, Dispersion, Model studies.

A mass transport model for shallow-buried hazardous wastes is described. Criteria for model development and required factors are outlined. The model assumes a stationary, homogeneous, and isotropic porous medium with a saturated and unsaturated zone containing an incompressible fluid of constant viscosity. The model was applied to migration of radioactive and nonradioactive hazard-

ous wastes from a shallow landfill. Results of the radioactive waste simulation for four different sites show that the effectiveness of each site depends on the radionuclides to be disposed of and on each site's particular combination of hydrogeological and radiochemical characteristics. The model can be related conceptually to other dispersion methodologies and discharge surfaces and is ideally suited for comparative quantitative evaluations and sensitivity analyses. It can be simplified for a single-zone problem and can be extended to time-dependent sources. It is not limited by the magnitude of space and time considerations. It can evaluate a given site, select the most suitable site among several candidates, or determine the extent of engineering or waste quantity limitations on the source term. (Purdin-NWWA)
W80-06019

SINGULARITIES IN DARCY FLOW THROUGH POROUS MEDIA,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W80-06021

GROUND WATER SIMULATION USING A ONE DIMENSIONAL FLOW MODEL,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 15, No 6, p 1618-1627, December, 1979. 6 Fig, 3 Tab, 7 Ref. OWRT-C-6301(No 5229)(4).

Descriptors: *Ground water movement, *Water quality, *Computer models, Simulation analysis, Steady flow.

A simple quantity and quality flow simulation model is presented which requires much less computer time and storage than complex two-dimension flow models and gives reasonably accurate results. The model divides the saturated zone into sections along the length of a river. Each section is homogeneous and isotropic with respect to the permeability of the unconfined aquifer. Average water table elevation and aquifer thickness in a section can be used with Darcy's law to determine steady state flow for or into that section. The quality of water can be represented by the average TDS value in any section, and dispersion effects are ignored. The model simulated the ground water basin in San Luis Rey River in Southern California and results were compared with those of a USGS model. It was found that the simple model gave results which were consistently within five percent of the USGS model results. Thus, one dimensional ground water flow models can be useful tools in the initial planning process where high accuracies are not required, and considerable time and money can be saved. (Purdin-NWWA)
W80-06044

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1978--VOLUME 1. ARKANSAS RIVER BASIN, RED RIVER BASIN, SABINE RIVER BASIN, NECHES RIVER BASIN, TRINITY RIVER BASIN, AND INTERVENING COASTAL BASINS,
Geological Survey, Austin, TX. Water Resources Div.
Geological Survey Water-Data Report TX-78-1, October 1979. 645 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Arkansas River basin, *Red River basin, *Sabine River basin, *Neches River basin, *Trinity River basin.

Surface-water data for the 1978 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. This volume (volume 1) includes the Arkansas River, Red River, Sabine River, Neches River, Trinity River, and intervening Coastal basins. Data consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperation State and Federal agencies in Texas. (Kosco-USGS)
W80-06048

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1978--VOLUME 2. SAN JACINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN, AND INTERVENING COASTAL BASINS,
Geological Survey, Austin, TX. Water Resources Div.
Geological Survey Water-Data Report TX-78-2, October 1979. 515 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *San Jacinto River basin, *Brazos River basin, *San Bernard River basin.

Surface-water data for the 1978 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. This volume (volume 2) includes the San Jacinto River, Brazos River, San Bernard River and intervening Coastal basins. Data consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Rederal agencies in Texas. (Kosco-USGS)
W80-06049

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1978--VOLUME 3. COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUADALUPE RIVER BASIN, NUECES RIVER BASIN, RIO GRANDE BASIN, AND INTERVENING COASTAL BASINS,
Geological Survey, Austin, TX. Water Resources Div.
Geological Survey Water-Data Report TX-78-3, October 1979. 595 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface waters, *Water quality, Gaging stations,Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Colorado River basin, *Lavaca River basin, *Guadalupe River basin, *Nueces River basin, *Rio Grande basin.

Surface-water data for the 1978 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. This volume (volume 3) includes the Colorado River, Lavaca River, Guadalupe River, Nueces River, Rio Grande, and intervening Coastal basins. Data consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (Kosco-USGS)
W80-06050

MAPS SHOWING GROUND-WATER CONDITIONS IN THE HOPI AREA, COCONINO AND NAVAJO COUNTIES, ARIZONA--1977,
Geological Survey, Tucson, AZ. Water Resources Div.
C. D. Farrar.
Available from OFSS, Box 25425, Fed. Ctr. Denver, CO. 80225. Paper copy $16.00, microfiche $2.00. Geological Survey open-file report 80-3 (WRI), January 1980. 4 Sheets, 16 Ref.

Descriptors: *Maps, *Groundwater resources, *Arizona, *Aquifer characteristics, *Water wells, Water levels, Water quality, Water analysis, Dissolved solids, Fluorides, Water yield, Hydrogeology, *Coconino County(AZ), *Navajo County(AZ).

The Hopi area includes about 3,200 square miles in northeastern Arizona and is mostly in the Navajo and Hopi Indian Reservations. Ground water occurs in several aquifers that are made up of one or more formations. The main sources of ground water are the Coconino aquifer, the Chinle Formation, the N and D aquifers, the Toreva and Bidahochi Formations, and the alluvium. Ground-water development has been slight; in 1977 about 425 acre-feet of ground water was withdrawn in the Hopi area. Information on the maps includes a designation of the principal aquifer that furnishes water to wells, depth to water, altitude of the water level, and chemical quality of the water. Scale 1:125,000. (Kosco-USGS)
W80-06052

GENERALIZED CONFIGURATION OF THE BOTTOM OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahasses, FL. Water Resources Div.
R. M. Wolansky, G. L. Barr, and R. M. Spechler.
Available from OFSS, Box 25425, Fed. Ctr. Denver, CO. 80225. Paper copy $2.50, microfiche $0.50. Geological Survey open-file report 79-1490 (WRI), 1979. 1 Sheet, 22 Ref.

Descriptors: *Maps, *Aquifers, *Florida, *Water levels, Water wells, Aquicludes, Geohydrologic units, Groundwater barriers, Hydrogeology, *Floridan aquifer, *Southwest Florida Management District.

This map presents the configuration of the bottom of the Floridan aquifer in the Southwest Florida Water Management District. The bottom of the aquifer generally corresponds to the beginning of consistent intergranular evaporites occurring in either the Avon Park, Lake City, or Oldsmar Limestones of Eocene age. The altitude of the bottom of the aquifer varies from about 600 feet below the National Geodetic Vertical Datum of 1929 in the north to about 3,000 feet below the datum in the South. (Kosco-USGS)
W80-06054

GENERALIZED THICKNESS OF THE CONFINING BED OVERLYING THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
A. Buono, R. M. Spechler, G. L. Barr, and R. M. Wolansky.
Available from OFSS, Box 25425, Fed. Ctr. Denver, Co. 80225. Paper copy $2.50, microfiche $0.50. Geological Survey open-file report 79-1171 (WR(), 1979. 1 Sheet. 17 Ref.

Descriptors: *Maps, *Aquicludes, *Aquifers, *Florida, Geohydrologic units, Aquifer characteristics, Groundwater barriers, Hydrogeology, *Floridan aquifer, *Southwest Florida Management District.

This map presents the thickness of the confining bed overlying the Floridan aquifer in the Southwest Florida Water Management District and adjacent areas. The bed separates the surficial aquifer from the underlying Floridan aquifer. Lithologic logs and information from quarries were used in conjunction with an unpublished map to compile this map at 1:250,000 scale. Units included in the confining bed are: clay, sandy clay and marl, undifferentiated with respect to age, the Hawthorn Formation, and the unconsolidated sections of the Tampa Limestone. (Kosco-USGS)
W80-06055

CLASSIFICATION OF GROUND-WATER RECHARGE POTENTIAL IN THREE PARTS OF SANTA CRUZ COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W80-06056

WATER-QUALITY DATA FOR CANALS IN EASTERN BROWARD COUNTY, FLORIDA, 1975-78,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. H. Sonntag.
Available from the OFSS Box 25425, Fed. Ctr. Denver Co 80225, paper copy $21.25, microfiche $3.50. Geological Survey open-file report 80-68, 1980. 161 p, 2 Fig, 8 Tab, 1 Ref.

Descriptors: *Water quality, *Canals, *Florida, *Basic data collections, *Chemical analysis, Surface waters, Environmental effects, Urban runoff, Monitoring, Nutrients, Pesticides, Trace elements, Bottom sediments, Coliforms, *Eastern Broward County(FL).

Increased urbanization in Broward County has contributed to canals being used as receptacles for urban wastes, sewage effluent, and stormwater runoff. The introduction of contaminants into the canals may affect the water quality. In 1969 the U.S. Geological Survey, in cooperation with the Broward County Pollution Control Board and the South Florida Water Management District, began to monitor the water-quality in canals of eastern Broward County. This report presents selected water-quality data collected from the canals, October 1974 through September 1978, in eastern Broward County. (Kosco-USGS)
W80-06061

SURFICIAL GEOLOGY OF PULASKI QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
T. S. Miller, and E. H. Muller.
Available from the OFSS Box 25425, Fed. Ctr. Denver Co 80225, paper copy $1.75, microfiche $50. Geological Survey open-file report 79-1343 (WRI), 1979. 1 Sheet.

Descriptors: *Geology, *Maps, *New York, *Petrology, *Groundwater potential, Glacial aquifers, Water wells, Natural resources, *Oswego County(NY).

The location and extent of 14 kinds of surficial deposits in Pulaski quadrangle, Oswego County, N.Y., are mapped on a 7.5 minute U.S. Geological Survey topographic quadrangle map. The map was prepared to indicate the lithology and potential for ground-water development at any specific location. (Kosco-USGS)
W80-06062

WATER-QUALITY DATA FROM FIVE OREGON STREAM BA
Geological Survey, Portland, OR. Water Resources Div.
T. L. Miller.
Available from the OFSS Box 25425, Fed. Ctr. Denver, Co 80225, paper copy $13.00, microfiche copy $3.50. Geologica Survey open-file report 79-1535, 19179. 98 p, 6 Fig, 6 Tab, 5 Ref.

Descriptors: *Water quality, *Data collections, *Oregon, *Streams, *Small watersheds, Low flow, Monitoring, Water analysis, Hydrologic data.

The U.S. Geological Survey collected water-quality data in five Oregon stream basins during summer low-flow conditions in 1977 and 1978. During the two sampling periods, a total of 18 different sites were sampled. Several sites were sampled twice in 1977, and some sites were sampled in both 1977 and 1978. Included in the sampling were diel trace of dissolved oxygen, temperature, specific conductance, pH, and solar radiation. In addition, periphyton and benthic invertebrate samples were collected and identified. (Kosco-USGS)
W80-06067

GEOHYDROLOGIC DATA FOR THE LOWER WOOD RIVER GROUND-WATER RESERVOIR, RHODE ISLAND,
Geological Survey, Providence, RI. Water Resources Div.
D. C. Dickerman, and P. J. Silva.
Rhode Island Water Resources Board Water Information Series Report 4, 1980. 193 p, 26 Fig, 1 Plate, 24 Tab, 8 Ref.

Descriptors: *Hydrogeology, *Hydrologic data, *Groundwater resources, *Rhode Island, *Aquifer characteristics, Data collections, Sites, Stratigraphy, Water resources development, Test wells, Observation wells, Lithologic logs, Water levels, Particle size, Sampling, Chemical analysis, Water quality, Seismology, Resistivity, *Lower Wood River, Ground-water reservoir(RI) *Pawcatuck River basin(RI), Stratified-drift deposits.

Geohydrologic data were collected in a 31.0-square-mile study area in southern Rhode Island, which includes the Lower Wood River groundwater reservoir. The data, which are mainly limited to the stratified-drift aquifer, are presented in tabular form and are being used by the Rhode Island Water Resources Board in planning and developing the ground-water resources of the Pawcatuck River basin. The data include descriptions of the depths, yields, and construction features of 424 selected wells and test holes,; lithologic logs of 193 wells and test holes; particle-size distribution for 290 lithologic samples, description 12 aquifer tests, velocity and layer thickness at 44 seismic shot points, apparent resistivity at 21 sites, water-level data; surface-water-quality data, low-flow discharge measurements; and stream discharge data. Chemical analyses of water samples from 198 selected wells and test holes are also included. The location of data-collection sites and the area underlain by stratified-drift deposits are shown on a two part plate on a 1:12,000 scale topographic base map. Figures show the location of aquifer test sites, pumping wells, observation wells, and generalized lithologic logs of well (Kosco-USGS)
W80-06068

WATER RESOURCES DATA FOR CONNECTICUT, WATER YEAR 1979,
Geologial Survey, Hartford, CT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-193410, Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CT-79-1, April 1980. 366 p, 4 Fig, 1 Tab.

Descriptors: *Connecticut, *Hydrologic data, *Surface waters, *Groundwater, *Water quallity, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, conrents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report contains records for water discharge at 56 gaging stations; tidal volume at 1 gaging station; stage only at 2 tidal-gaging stations; stage only at 1 gaging station; contents at 36 Lakes and reservoirs; water quality at 50 gaging stations, 5 lakes and reservoirs, 2 harbors, 34 wells and 1 spring; and water levels at 66 observation wells. Also included are 41 crest-stage partial-record stations. Additional water data were collected at various sites not part of the systematic data-collection program and are published as miscellaneous mesuremens and analyses. A few pertinent stations (not included above) in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Connecticut. (Kosco-USGS)
W80-06160

WATER RESOURCES DATA FOR WISCONSIN, WATER YEAR 1979,
Geological Survey, Madison, WI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195589, Price codes: A23 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WI-79-1, April 1980. 514 p, 5 Fig.

Descriptors: *Wisconsin, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water-resources data for the 1979 water year for Wisconsin include records of streamflow at gaging stations, partial-record stations, and miscellaneous sites; records of reservoir storage; records of chemical, physical, and biological characteristics of surface water, ground water, and precipitation, and records of water levels in observation wells. Records for a few gaging stations in bordering States also are included. These data represent that part of the national Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Wisconsin. (Kosco-USGS)
W80-06161

WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1979,
Geological Survey, Lincoln, NE. Water Resouces Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-200157, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NE-79-1, May 1980. 501 p, 5 Fig, 3 Tab.

Descriptors: *Nebrask, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for Nebraska consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 161 gaging stations; stage and contents for 10 lakes and reservoirs; water quallity for 60 gaging stations, 10 ungaged stations, 34 partial-record flow stations, and 276 wells; and water levels for 63 observation wells. Also included are 7 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (USGS)
W80-06162

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1979--VOLUM 1. NEW YORK EXCLUDING LONG ISLAND,
Geological Survey, Albany, NY. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195928, Price codes: A24 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NY-79-1, May 1980. 538 p, 8 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 187 gaging stations, stage only at 22 gaging stations, stage and contents at 12 gaging stations and 18 other lakes and reservoirs, water quality at 60 gaging stations and 43 wells, and water levels at 44 observation wells. Also included are data for 133 crest-stage and 15 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are publshed as miscellaneous measuremens and analyses. These data together with the data in volume 2 represent that part of the national Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in New York. (Kosco-USGS)
W80-06163

WATER RESOURCES DATA FOR NEW YORK, WATER YEAR 1979--VOLUME 2. LONG ISLAND,
Geological Survey, Albany, NY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-192891, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report NY-79-2, April 1980. 306 p, 8 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Long Island(NY).

Water resources data for the 1979 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservois; water quality of precipitation; and water levels and water quality of ground water wells. This volume contains records for water discharge at 17 gaging stations; water quality at 17 gaging stations, 610 wells, and 3 precipitation stations; and water levels at 130 observation wells. Also included are data for 79 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the national Water Data System operated by the U.S. Geological Survey in cooperation with State, Federal, and other agencies in New York. (Kosco-USGS)
W80-06164

WATER RESOURCES DATA FOR SOUTH DAKOTA, WATER YEAR 1979,
Geological Survey, Huron, SD. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-195936, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report SD-79-1, May 1980. 353 p, 6 Fig.

Descriptors: *South Dakota, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for South Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of laks and reservoirs; and water levels in wells. This report contains discharge records for 109 gaging stations, stage and contents for 10 lakes and reservoirs, water quality for 22 gaging stations and 62 wells, and water levels for 16 observation wells. Also included are 97 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collectin program, and are published as miscellaneous meaurements and analyses. These data represent that part of the National Water Data System oprated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (Kosco-USGS)
W80-06165

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1978--VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY,
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118730, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-78-2, September 1979. 566 p, 3 Fig, 1 Tab.

Descriptors: *California, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperarure, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Volume 2 of water resources data for the 1978 water year for California consists of records of stage, discharge, and water quality of streams and wells; stage, contents and water quality in lakes and reservoirs, and water levels in wells. This volume contains discharge records for 166 gaging stations, stage and contents for 20 lakes and reservoirs, water quality for 134 stations and 13 wells and water levels for 17 observation wells. Also included are 15 crest-stage partial-record stations and 73 low-flow partial-record stations. These data represent that part of the national Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (Kosco-USGS)
W80-06166

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1978--VOLUME 3. SOTHR CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-155534, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-78-3, january 1980. 429 p, 12 Fig, 1 Tab.

Descriptors: *California, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Great Basin, *Walker River, *Truckee River, *Souther central valley basins.

Volume 3 of water resources data for the 1978 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This volume contains discharge records for 179 gaging stations, stage and contents for 40 lakes and reservoirs, gage-height records for 2 lakes, and water quality for 55 stations, and water levels for 22 observation wells. Also included are 34 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as special investigations and miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (Kosco-USGS)
W80-06167

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1978 VOLUME 4. NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-118748 ,Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-78-4, September 1979. 493 p, 12 Fig, 1 Tab.

Descriptors: *California, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging statons, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Northern Central Valley basins(CA), *The Great Basin(CA), *Honey Lake basin(CA).

Volume 4 of the water resources data for the 1978 water year for California consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality in lakes and water quality inlakes and reservoirs; and warer levels in wells. This volume contains discharge records for 196 gaging stations, stage and contents for 34 lakes and reservoirs precipitation data for 2 stations, water quality for 81 stations, and water levels for 1 observation well. Also included are 23 crest-stage partial-record stations, 35 low-flow partial-record stations, and 3 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are publshed as special investigations and miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (Kosco-USGS)
W80-06168

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1979--VOLUME 1. CENTRAL AND NORTHERN LOUISIANA.
Geological Survey, Baton rouge, LA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-153299, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report LA-79-1, January 1980. 426 p, 9 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperatue, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Central and northern Louisiana.

Water resources data for the 1979 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes, and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 78 gaging stations (including stage for 72 of thse stations); stage only for 42 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 146 surface-water stations (including 22 gaging stations, 52 miscellaneous sites, and 24 lakes), and 335 wells; and water levels for 685 observation wells. Also included are data for 212 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in th systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the national Water Data System operated by the U.S.

Geological Survey and cooperating State and Federal agencies in Louisiana. (Kosco-USGS)
W80-06169

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1979--VOLUME 2. SOUTHERN LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-177579, Price codes: A20 in paper copy, A01 in microfiche copy. Geological Survey, Baton Rouge, LA. Water Resources Div.

Descriptors: *Louisiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Southern Louisiana.

Water resources data for the 1979 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volums, contains records for water discharge at 78 gaging stations (including stage for 72 of these stations); stage only for 42 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 146 surface-water stations (including 22 gaging stations, 52 miscellaneous sites, and 24 lakes), and 335 wells; and water levels for 685 observation wells. Also included are data for 212 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (Kosco-USGS)
W80-06170

WATER RESOURCES DATA FOR LOIISIANA, WATER YEAR 1979--VOLUM 3. COASTAL LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Geological Survey Water-Data Report LA-79-3, January 1980. 284 p, 6 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gagin stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Coastal Louisiana.

Water resources data for the 1979 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 78 gaging stations (including stage for 72 of these stations): stage only for 42 gaging stations and 10 lakes; contents for 1 reservoir: water quality for 146 surface-water stations (including 22 gaging stations, 52 miscellaneous sites, and 24 lakes), and 335 well; and water levels for 685 observation wells. Also included are data for 212 crest-stage and flood profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (Kosco-USCS)
W80-06171

8. ENGINEERING WORKS

8A. Structures

RADIAL PUMP SAVES ON WATER DRAWING,
World Water, Vol 3, No 4, p 39, April, 1980. 1 Fig.

Descriptors: *Radial wells, *Induced infiltration, Design, Water yield, Feasibility studies, Conjunctive use, Artificial recharge, Storage.

A large-diameter radial well system can extract water by induced infiltration without any direct impact on the waterway. The 4-6 m-diameter well is sunk to depths of up to 65 m. Horizontal collector pipes are driven radially out from the well into the aquifer. The wide diameter of the well facilitates installation and maintenance. The design of this system should be based on a detailed hydrogeologic investigation and feasibility study in order to obtain the most economical yield. Radial wells are ideally suited for conjunctive use schemes. (Purdin-NWWA)
W80-06046

WATER FROM THE WATERSKLOOF,
Department of Water Affairs, Pretoria (South Africa).
The Civil Engineer in South Africa, Vol 20, No 12 p 331 December 1978, 3 Fig.

Descriptors: *Tunnel construction, *Irrigation systems, *Irrigation engineering, *Tunnel linings, Concrete construction, Excavation, Tunnels, Tunneling, Rock mechanics, Dam construction, Civil engineering, Clays, Drilling equipment, Weirs, Hydraulic structures, *Watershed management, *South Africa.

Various problems were encontered during excavations for the tunnel system of the Theewatersklof dam. The tunnel system has four basic sections: (1) Theewaterskloof to Berg River, (2) Berg River to Eerste River, (3) Eerste River through Stellenboschberg, and (4) branch tunnel from the main tunnel towards the Berge River Valley. Total tunnel excavations will e 513,000 cu m. A total of 360,000 cu m of concrete will be used. Excavation on one heading in the Theewaterskloof-Berg River area was held up for 38 months due to a badly faulted area. A tunnel shield had to be used for excavation in the Jonkershoek portal which is clay. This showed forward progress to 300 m in 19 months. Water diverted from the Berg River flows direct to delivery points or back to storage in the Theewaterskloof dam. Outlet works in the Jonkershoek Valley discharge water into the Kleinplaas dam, creating a balancing and storage dam for the Stellenboschberg tunnel. Concrete lining of the five headings will be done simultaneously in 1980. The scheme will be completed with construction of the Assegaaibos dam and distribution system. (Seigler-IPA)
W80-06073

8B. Hydraulics

DEPTH CONSTRAINTS ON THERMAL STORAGE WELLS,
Houston Univ., TX.
G. O. Morrell, and R. E. Collins.
In: 2nd Invitational Well-Testing Symposium Proceedings, October 25-27, 1978, Berkeley, California, Lawrence Berkeley Laboratory, University of California, Berkeley, p 108-111. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Thermal water, *Storage, *Aquifers, *Water wells, *Depth, Electric power demand, Water temperature, Flow rates, Steam, Scaling, Pumping, Injection wells, Pressure head, Vapor pressure, Aquifer characteristics, Constraints, Equations.

Equations are derived to compute curves showing the minimum depths required at different storage temperatures and flow rates to prevent steam formation and associated scaling in a pumped aquifer hot water storage well. A first order estimate of the power required for the downhole pump at a given depth and storage temperature was made by requiring that the pressure at the wellhead be greater than the vapor pressure of water. The exact constraint on depth for an aquifer storage system depends upon the specific parameters of the well-aquifer system. Once a storage temperature and maximum flow rate have been selected the most important variables are the permeability and thickness of the formation and the value of the skin factor, S, which depends upon drilling and completion techniques. Power requirements of the downhole pump depend upon the depth, flow rate and storage temperature. Power requirements could be very small or as much as 25% of the net electric power which can be generated from the retrieved hot water. (Purdin-NWWA)
W80-06025

COPPER RIVER HYDRAULICS STUDY AT MILLION DOLLAR BRIDGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
S. H. Jones, and W. F. Barber, Jr.
Available from OFSS, Box 25425, Fed. Ctr. Denver, CO. 80225. Paper copy $8.25, microfiche $4.50. Geological Survey open-file report 80-223, 1980. 6 p, 1 Fig, 2 Plates, 1 Tab, 14 Ref.

Descriptors: *Hydraulics, *Bridge design, *Alaska, *Mathematical studies, *Hydraulic properties, Discharge(Water), Profiles, Lake beds, River beds, Water levels, Bathymetry, Velocity, Flow, *Copper River(Alaska), *Million Dollar Bridge(Alaska).

The Copper River hydraulic conditions in the vicinity of the Million-Dollar Bridge, Alaska, at the outlet to Miles Lake are described. The water discharge, lake and river bed profiles, bathymetry, velocity, and direction of flow are presented. (Kosco-USGS)
W80-06051

OPTIMUM SPILLWAY BREADTH FOR GRAVITY DAMS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W80-06097

STABLE ALLUVIAL CANAL DESIGN,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W80-06129

8C. Hydraulic Machinery

REGULATORY AND ENVIRONMENTAL IMPLICATIONS OF GROUND WATER HEAT PUMPS,
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 6E.
W80-06030

DRILL PROVIDES UNMIXED SAMPLES,
For primary bibliographic entry see Field 7B.
W80-06045

8E. Rock Mechanics and Geology

BOLTING THE ROOF AT DRAKENSBERG,
Construction in Southern Africa, Vol 23, No 5, p 14, 15 and 17, August 1978.

Descriptors: *Underground powerplants, *Pumped storage, *Rock bolts, *Rock excavation, Tunnel construction, Underground structures, Corrosion control, Coatings, Rock mechanics, Drilling equipment, Tunneling, *Africa.

The Drakensberg Pumped Storage Scheme in Natal is requiring the excavation of some of the largest underground chambers ever to be constructed in Southern Africa. The dual purpose scheme will supply electricity to the National Grid during peak demand periods and store energy during off peak periods and will pump water into the Vaal catchment area to supplement the Witwatersrand water supply. Three large chambers are being constructed measuring up to 196 m long, 16 m wide; and 46 m high. Due to this size, the mudstone-sandstone-silstone geology of the rock, and the presence of corrosive water, a double corrosion protected resin anchored bolt system was selected for roof support. Dywidag bolts of West Germay were used. The threaded bolt has a plastic sheath and the annulus between the bolt and the sheathing is pre-grouted with rapid hardening cement. The thread runs the full length of the bolt allowing the bolt to be cut and used for any length needed. The bolts are inserted into a resin that sets in about four minutes and allows full load after one hour. The bolts re generally between 4 and 7 m long. It is estimated that approximately 39,000 primary and secondary bolts will be used for the scheme. (Seigler-IPA)
W80-06075

8I. Fisheries Engineering

ESTROGEN SEX REVERSAL OF TILAPIA AUREA,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
K. D. Hopkins, W. L. Shelton, and C. R. Engle.
Aquaculture, Vol 18, p 263-268, 1979, 2 Tab, 11 Ref OWRT B075-AL(2),1434-0001-8055.

Descriptors: *Chemical treatment, *Monosex offspring, *Tilapia aurea, Fish physiology, Fish reproductin, Fish genetics, Sex reversal(Fish), Diethylstilbestrol.

Chemical treatments were used to produce sex-reversed female (genetic male) Tilaphia aurea, which can be bred to produce monosex offspring. Various combinations of estrogens, two synthetic and one natural, an antiandrogen, and a 'pituitary blocking agent' were orally administered to sexually undifferentiated fry. Treatment periods were 4, 5, 6 and 8 weeks. Seven of the 36 treatments produced more than 50% females (alpha = 0.05.) Two treatments were more successful than the others: (1) 17-alpha-ethynylestradiol (EE) at 100 mg kg-1 diet in combination with methallibure (ME) at 100 mg kg-1 for six weeks and (2) EE-100 with ME-100 and cyproterone acetate (CA) at 100 mg kg for six weeks. These treatments produced fish that were 90% female. Comparisons of the treatments with and without CA indicated that Ca may lessen the hormone effectiveness of the treatments. Diethylstilbestrol was as potent as EE in comparable CA treatments.
W80-06035

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

WATER DATA AND SERVICES AVAILABLE FROM PARTICIPANTS IN THE NATIONAL WATER DATA EXCHANGE,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards.
Water Resources Bulletin, Vol 16, No 1, p 1-14, February 1980.

Descriptors: *Hydrologic data, *Information retrieval, *Organizations, *Information exchange, Water resources, Data storage and retrieval, *National Water Data Exchange(NAWDEX), *Member organizations.

The National Water Data Exchange (NAWDEX) was implemented in January 1976 as an interagency program managed by the U.S. Geological Survey. The program is directed at improving access to existing water and water-related data. Nearly 150 organizations from the Federal, State-governmental, local-governmental, interstate, academic, private, and foreign sectors currently participate in the program. This article describes the NAWDEX program and contains descriptions of the types of data and services available from organizations participating in NAWDEX. A point of contact for obtaining data and services is provided for each organization. (Kosco-USGS)
W80-06047

SUBJECT INDEX

V 1 3 / 1 9 O C 1 8 0 UMI

V 13/19 OCT 80 UMI

V
1
3
/
1
9
O
C
1
8
0
UMI

AUTHOR INDEX

V 13/19 OCT 80 UMI

ORGANIZATIONAL INDEX

V 13 / 19 OCT 80 UMI

V 1 3 / 1 9 O C 1 8 0 UMI

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
A. CENTERS OF COMPETENCE		
Illinois State Water Survey, Hydrology	W80-06084--06090 06092--06118 06122--06123 06125--06155 06182--06192 06194--06200	85
National Water Well Association, Water Well Construction Technology	W80-06014--06016 06018--06027 06030--06031 06044--06046	18
University of Wisconsin, Water Resources Economics	W80-06043	1
B. STATE WATER RESOURCES RESEARCH INSTITUTES	W80-06002--06005 06011--06012 06034--06035 06038--06041 06076--06082 06156--06159	23
C. OTHER		
Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W80-06042	1
Information Planning Associates, Inc.	W80-06006--06010 06037 06069--06075 06091 06119--06121	17
Ocean Engineering Information Service (Patents)	W80-06017, 06124 06028--06029 06036, 06059 06065 06172--06181 06193	18

ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
C. OTHER (Continued)		
Office of Water Research and Technology	W80-06001, 06013 06032--06033 06083	5
U. S. Geological Survey	W80-06047--06058 06060--06064 06066--06068 06160--06171	32

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V 13 / 19 OC 1 80 UMI

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

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6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

ABSTRACT SOURCES

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